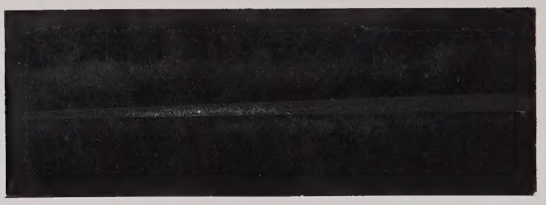
KEITHLEY

Model 6517 Electrometer

Repair Manual



Model 6517
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Repair Manual

Contains Servicing Information

KEITHLEY

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Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, rechargeable batteries, diskettes, and documentation.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

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Repair Manual

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Manual Print History

The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.

Revision A (Document Number 6517-902-01)..... April 1995

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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC main. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a screw is present, connect it to safety earth ground using #18 AWG or larger wire.

The symbol on an instrument or accessory indicates that 1000V or more may be present on the terminals. Refer to the product manual for detailed operating information.

Instrumentation and accessories should not be connected to humans.

Maintenance should be performed by qualified service personnel. Before performing any maintenance, disconnect the line cord and all test cables.

MODEL 6517 SPECIFICATIONS

VOLTS

RANGE	5½ DIGIT RESOLUTION	ACCURACY (1 Yr.)[1] 18°– 28°C ±(%rdg + counts)	TEMPERATURE COEFFICIENT 0°– 18°C & 28°– 50°C ±(%rdg + counts)/°C
2 V	10 µV	0.025 + 4	0.003 + 2
20 V	100 µV	0.025 + 3	0.002 + 1
200 V	1 mV	0.06 + 3	0.002 + 1

Note: [1]When properly zeroed, 5½ digit, 1 PLC (power line cycle), median filter on, digital filter =10 readings.

NMRR: 60dB on 2V, 20V, >55dB on 200V, at 50Hz or 60Hz ±0.1%.

CMRR: >120dB at DC, 50Hz or 60Hz.

INPUT IMPEDANCE: >200TΩ in parallel with 20pF, < 2pF guarded (10MΩ with zero check on).

SMALL SIGNAL BANDWIDTH AT PREAMP OUTPUT: Typically 100kHz (–3db).

AMPS

RANGE	5½ DIGIT RESOLUTION	ACCURACY (1 Yr.)[1] 18°– 28°C ±(%rdg + counts)	TEMPERATURE COEFFICIENT 0°–18°C & 28°–50°C ±(%rdg + counts)/°C
20 pA	100 aA[2]	1 + 30	0.1 + 5
200 pA	1 fA[2]	1 + 5	0.1 + 1
2 nA	10 fA	0.2 + 30	0.1 + 2
20 nA	100 fA	0.2 + 5	0.03 + 1
200 nA	1 pA	0.2 + 5	0.03 + 1
2 µA	10 pA	0.1 + 10	0.005 + 2
20 µA	100 pA	0.1 + 5	0.005 + 1
200 µA	1 nA	0.1 + 5	0.005 + 1
2 mA	10 nA	0.1 + 10	0.008 + 2
20 mA	100 nA	0.1 + 5	0.008 + 1

Note: [1]When properly zeroed, 5½ digit, 1 PLC (power line cycle), median filter on, digital filter =10 readings.

[2]aA =10^{-18}A, fA=10^{-15}A.

INPUT BIAS CURRENT: <3fA at TCAL. Temperature coefficient = 0.5fA/°C.

INPUT BIAS CURRENT NOISE: <750aA p-p (capped input), 0.1Hz to 10Hz bandwidth, damping on. Digital filter = 40 readings.

INPUT VOLTAGE BURDEN at TCAL ±1°C:

<20µV on 20pA, 2nA, 20nA, 2µA, 20µA ranges.

<100µV on 200pA, 200nA, 200µA ranges.

<2mV on 2mA range.

<4mV on 20mA range.

TEMPERATURE COEFFICIENT OF INPUT VOLTAGE BURDEN:

<10µV/°C on pA, nA, µA ranges.

PREAMP SETTLING TIME (to 10% of final value): 2.5s typical on pA ranges, damping off, 4s typical on pA ranges damping on, 9ms on nA ranges, 1ms on µA and mA ranges.

NMRR: >95dB on pA, 60dB on nA, µA, and mA ranges at 50Hz or 60Hz ±0.1%.

COULOMBS

RANGE	5½ DIGIT RESOLUTION	ACCURACY (1 Yr.)[1,2] 18°– 28°C ±(%rdg + counts)	TEMPERATURE COEFFICIENT 0°– 18°C & 28°– 50°C ±(%rdg + counts)/°C
2 nC	10 fC	0.4 + 5	0.04 + 3
20 nC	100 fC	0.4 + 5	0.04 + 1
200 nC	1 pC	0.4 + 5	0.04 + 1
2 µC	10 pC	0.4 + 5	0.04 + 1

Note: [1]Charge acquisition time must be <1000s, derate 1% for each additional 10,000s.

[2]When properly zeroed, 5½ digit, 1 PLC (power line cycle), median filter on, digital filter =10 readings.

INPUT BIAS CURRENT: <4fA at TCAL. Temperature coefficient = 0.5fA/°C.

OHMS

RANGE	5½ DIGIT RESOLUTION	ACCURACY[1] (10-100% Range) 18°-28°C (1 Yr.) ±(% rdg + cts)	TEMPERATURE COEFFICIENT (10-100% Range) 0°-18°C & 28°-50°C ±(% rdg + cts)	TEST VOLTS	AMPS RANGE
2 MΩ	10 Ω	0.125 + 1	0.01 + 1	40 V	200 µA
20 MΩ	100 Ω	0.125 + 1	0.01 + 1	40 V	20 µA
200 MΩ	1 kΩ	0.15 + 1	0.015 + 1	40 V	2 µA
2 GΩ	10 kΩ	0.225 + 1	0.035 + 1	40 V	200 nA
20 GΩ	100 kΩ	0.225 + 1	0.035 + 1	40 V	20 nA
200 GΩ	1 MΩ	0.35 + 1	0.110 + 1	40 V	2 nA
2 TΩ	10 MΩ	0.35 + 1	0.110 + 1	400 V	2 nA
20 TΩ	100 MΩ	1.025 + 1	0.105 + 1	400 V	200 pA
200 TΩ	1 GΩ	1.15 + 1	0.125 + 1	400 V	20 pA

Note: [1]Specifications are for auto V-source ohms, when properly zeroed 5½ digit, 1 PLC, median filter on, digital filter = 10 readings. If user selectable voltage is required, use manual mode. Manual mode displays resistance (up to 10^{18}Ω) calculated from measured current. Accuracy is equal to accuracy of V-source plus accuracy of selected Amps range.

PREAMP SETTLING TIME: Add voltage source settling time to preamp settling time in Amps specification.

VOLTAGE SOURCE

RANGE	STEP SIZE	ACCURACY (1 Yr.) 18°– 28°C ±(% setting+offset)	TEMPERATURE COEFFICIENT 0°– 18°C & 28°– 50°C ±(% setting+offset)/°C
100 V	5 mV	0.15 + 10 mV	0.005 + 1 mV
1000 V	50 mV	0.15 + 100 mV	0.005 + 10 mV

MAXIMUM OUTPUT CURRENT:

±10mA; active current limit at <11.5mA for 100V range.

±1mA; active current limit at <1.15mA for 1000V range.

SETTLING TIME:

<8ms to rated accuracy for 100V range.

<50ms to rated accuracy for 1000V range.

NOISE:

<150µV p-p from 0.1Hz to 10Hz for 100V range.

<1.5mV p-p from 0.1Hz to 10Hz for 1000V range.

TEMPERATURE (THERMOCOUPLE)

THERMOCOUPLE TYPE	RANGE	ACCURACY (1 Yr.)[1] 18°– 28°C ±(% rdg + °C)
K	–190°C to 1350°C	± (0.27% ± 1.5°C)

Note: [1]Excluding probe errors, TCAL ± 5°C, 1 PLC integration time.

HUMIDITY

RANGE	ACCURACY (1 Yr.)[1] 18°– 28°C ±(% rdg + % RH)
0 - 100%	± (0.3% +0.5)

Note: [1]Humidity probe accuracy must be added. This is ± 3% RH, for Model 6517-RH, up to 65°C probe environment, not to exceed 85°C.

IEEE-488 BUS IMPLEMENTATION

MULTILINE COMMANDS: DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

IMPLEMENTATION: SCPI (IEEE-488.2, SCPI-1994.0); DDC (IEEE-488.1).

UNILINE COMMANDS: IFC, REN, EOI, SRQ, ATN.

INTERFACE FUNCTIONS: SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

PROGRAMMABLE PARAMETERS: Function, Range, Zero Check, Zero Suppress, EOI (DDC mode only), Trigger, Terminator (DDC mode only), 100-Reading Storage (DDC mode), 15706 Max. Reading Storage (SCPI mode), Calibration (SCPI mode only), V-Source Output, Display Format, SRQ, Status (including V-Source I-Limit), Output Format, Guard.

ADDRESS MODES: TALK ONLY and ADDRESSABLE.

TRIGGER TO READING DONE: 150ms typical, with external trigger.

RS-232 IMPLEMENTATION:

Supports: SCPI 1994.0.

Baud Rates: 300, 600, 1200, 2400, 4800, 9600, 19.2k.

Protocols: Xon/Xoff, 7 or 8 bit ASCII, parity-odd/even/none.

Connector: DB-9 TXD/RXD/GND.

GENERAL

DISPLAY: 6½-digit vacuum fluorescent multiline.

OVERRANGE INDICATION: Display reads "OVERFLOW".

RANGING: Automatic or manual.

CONVERSION TIME: Selectable 0.01 PLC to 10 PLC.

PROGRAMS: Provide front panel access to IEEE address, choice of engineering units or scientific notation, and digital calibration.

MAXIMUM INPUT: 250V peak, DC to 60Hz sine wave; 10s per minute maximum on mA ranges.

MAXIMUM COMMON MODE VOLTAGE (DC to 60Hz sine wave): Electrometer, 500V peak; V Source, 750V peak.

ISOLATION (Meter COMMON to chassis): Typically $10^{10}\Omega$ in parallel with 500pF.

INPUT CONNECTOR: Three lug triaxial on rear panel.

2V ANALOG OUTPUT: 2V for full range input. Inverting in Volts mode. Output impedance 10kΩ.

PREAMP OUTPUT: Provides a guard output for Volts measurements. Can be used as an inverting output or with external feedback in Amps and Coulombs modes.

EXTERNAL TRIGGER: TTL compatible External Trigger and Electrometer Complete.

GUARD: Switchable voltage guard available.

DIGITAL I/O AND TRIGGER LINE: Available, see manual for usage.

EMI/RFI: Meets VDE-0871 and FCC Class B limits.

TEST SEQUENCES: Device-Characterization (Diode, Capacitor, Cable, Resistor), Resistivity, Surface-Insulation-Resistance, Sweep.

READING STORAGE: 100 readings (DDC mode), 15706 max. readings (SCPI mode).

READING RATE:

To internal buffer	125 readings/second[1]
To IEEE-488 bus	115 readings/second[1,3]
To front panel	17 readings/second[2]
Bus transfer	2500 readings/second[3]

Note: [1] 0.01 PLC, digital filters off, front panel off, temperature + RH off.
[2] 1.00 PLC, digital filters off, temperature + RH off.
[3] Binary transfer mode.

DIGITAL FILTER: Median and averaging.

ENVIRONMENT:

Operating: 0°-50°C; relative humidity 70% non-condensing, up to 35°C.

Storage: –25° to +65°C.

WARM-UP: 1 hour to rated accuracy (see manual for recommended procedure).

POWER: 105–125V or 210–250V (external switch selected), 90–110V (internal switch selected), 50–60Hz, 50VA.

PHYSICAL:

Case Dimensions: 90mm high × 214mm wide × 369mm deep (3½ in. × 8½ in. × 14½ in.).

Working Dimensions: From front of case to rear including power cord and IEEE-488 connector: 15.5 inches.

Net Weight: <4.6 kg (<10.1 lbs.).

Shipping Weight: <9.5 kg (<21 lbs.).

ACCESSORIES SUPPLIED:

Model 237-ALG-2 Low Noise Triax Cable, 3-slot Triax to Alligator clips 2m (6.6 ft.).

Model 8606 High Performance Modular Probe Kit.

Model 8607 Safety High Voltage Dual Test Leads.

Model 6517-TP Thermocouple Input Lead.

CS-459 Interlock Connector.

Specifications subject to change without notice.

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1

Routine Maintenance

1.1 Introduction

The information in this section deals with routine type maintenance that can be performed by the operator. This information is arranged as follows:

1.2 **Line voltage selection:** Describes how to select the correct line voltage.

1.3 **Line fuse replacement:** Explains how to replace a blown power line fuse.

1.4 **INPUT connector cleaning:** Discusses how to clean the INPUT jack should its insulators become contaminated.

1.5 **Firmware updates:** Recommends a course of action for firmware updates provided by Keithley.

1.2 Line voltage selection

The operating voltage is selected using the rear panel SELECTED LINE VOLTAGE switch (see Figure 1-1). Before connecting the Model 6517 to line power, be sure that line voltage selection switch is set for the correct voltage as marked on the rear panel. Settings are as follows:

- 115V: 105-125V (90-110V when set internally)
- 230V: 210V-250V (180-220V when set internally)

CAUTION

Operating the Model 6517 on an incorrect line voltage may result in instrument damage. If the line voltage setting is changed, the line fuse will also require replacement. See paragraph 1.3.

1.3 Line fuse replacement

WARNING

Disconnect the line cord at the rear panel, and remove all test leads connected to the instrument (front and rear) before replacing the line fuse.

The power line fuse is accessible from the rear panel, just below the AC power receptacle (see Figure 1-1). Perform the following steps to replace the line fuse:

1. Insert a flat-bladed screwdriver into the slot of the fuse carrier.
2. While pushing in, turn the screwdriver counter-clockwise until the spring-loaded fuse carrier releases from the fuse holder.
3. Pull out the fuse carrier and replace the fuse with the type specified in Table 1-1.

CAUTION

To prevent instrument damage, use only the fuse type specified in Table 1-1.

4. Re-install the fuse carrier.

NOTE

If the power line fuse continues to blow, a circuit malfunction exists and must be corrected. Refer to the troubleshooting section of this manual for additional information.

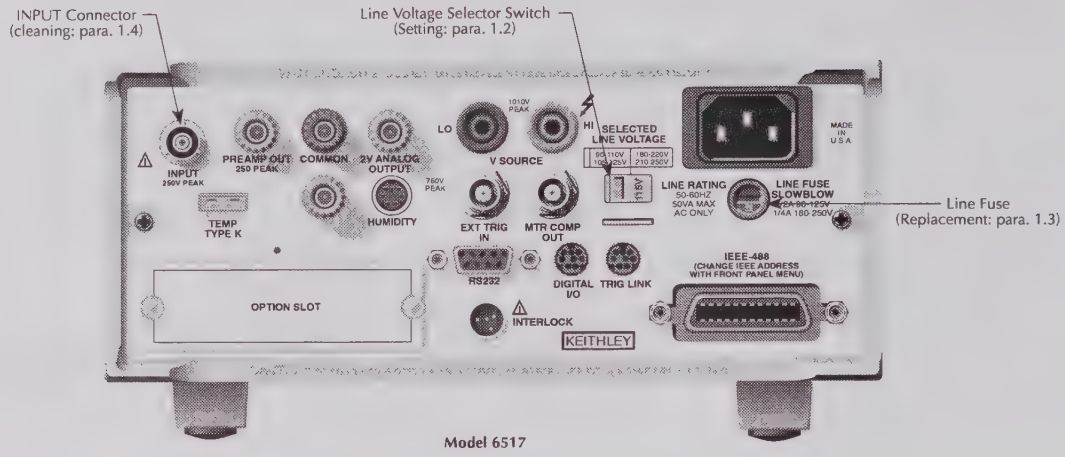


Figure 1-1
Rear panel

Table 1-1
Power line fuse

Line voltage	Rating	Keithley part no.
90-125V	250V, 1/2A, Slow Blow	FU-71
180-250V	250V, 1/4A, Slow Blow	FU-96-4

Note: 5 × 20mm fuses required

1.4 INPUT connector cleaning

The INPUT connector insulators may become contaminated, either through touching, or from air-borne deposits. Such contamination may reduce the input impedance of the Model 6517, affecting high-impedance and low-current measurements.

If the INPUT connector insulators become contaminated, they should be cleaned using a small foam swab dipped in clean methanol. After cleaning, blow dry with dry nitrogen or allow the connector to dry for several hours in a 50°C, low-humidity environment before use. To avoid further contamination after cleaning, keep the connecting cable or the dust cap on the INPUT connector at all times.

1.5 Firmware updates

It is possible that you may receive a firmware update from Keithley to enhance operation. The firmware for the main microprocessor is contained in two ROMs (U637 and U638) installed in sockets on the digital board to make replacement relatively easy.

The replacement procedure requires that the case cover be removed, and these static-sensitive devices require special handling. As a result, the firmware update procedure should be performed only by qualified service personnel. The procedure to replace the ROMs is located in paragraph 3.7.

2
Troubleshooting

2.1 Introduction

This section of the manual will assist you in troubleshooting the Model 6517. Included are self-tests, troubleshooting tables, and circuit descriptions. It is left to the discretion of the repair technician to select the appropriate tests and documentation needed to troubleshoot the instrument. Note that disassembly drawings are located at the end of Section 3, while component layout drawings may be found at the end of Section 4.

WARNING

The information in this section is intended for qualified service personnel. Some of these procedures may expose you to hazardous voltages. Do not perform these hazardous procedures unless you are qualified to do so.

This section is arranged as follows:

2.2 Repair considerations: Covers some considerations that should be noted before making any repairs to the Model 6517.

2.3 Power-on test: Describes the tests that are performed on its memory elements each time the instrument is turned on.

2.4 Front panel tests: Provides the procedures to test the functionality of the front panel keys and the display.

2.5 Principles of operation: Gives an overview of operating principles for the analog board, digital board, display board, and power supply.

2.6 Circuit board checks: Summarizes basic tests for the various circuit boards to aid in troubleshooting.

2.2 Repair considerations

Before making any repairs to the Model 6517, be sure to read the following considerations.

CAUTION

The PC-boards are built using surface mount techniques and require specialized equipment and skills for repair. If you are not equipped and/or qualified, it is strongly recommended that you send the unit back to the factory for repairs or limit repairs to the PC-board replacement level (see following NOTE). Without proper equipment and training, you could damage a PC-board beyond repair.

NOTE

For units that are out of warranty, completely assembled PC-boards can be ordered from Keithley to facilitate repairs.

1. Repairs will require various degrees of disassembly. Disassembly instructions for the Model 6517 are located in Section 3 of this manual.
2. Do not make repairs to surface mount PC-boards unless equipped and qualified to do so (see previous CAUTION).
3. When working inside the unit and replacing parts, be sure to adhere to the handling precautions and cleaning procedures explained in paragraph 3.2.
4. Many CMOS devices are installed in the Model 6517. These static-sensitive devices require special handling as explained in paragraph 3.3.

5. Whenever a circuit board is removed or a component is replaced, the Model 6517 must be recalibrated.

2.3 Power-on test

During the power-on sequence, the Model 6517 will perform a checksum test on its ROMs (U637 and U638) and test its RAM (U635 and U636). A ROM OK or RAM OK message will be displayed upon successful completion. However, if one of these tests fail, the instrument may lock up completely.

2.4 Front panel tests

There are three Front Panel Tests; one to test the functionality of the front panel keys, and two to test the display. In the event of a test failure, refer to paragraphs 2.5.1 and 2.6.1 for details on troubleshooting the display board.

2.4.1 KEYS test

The KEYS test allows you to check the functionality of each front panel key. Perform the following steps to run the KEYS test.

1. Display the MAIN MENU by pressing the MENU key.
2. Select TEST, and press ENTER to display the SELF-TEST MENU.
3. Select FRONT-PANEL-TESTS, and press ENTER to display the following menu:

   FRONT PANEL TESTS
   KEYS DISPLAY-PATTERNS CHAR-SET

4. Select KEYS, and press ENTER to start the test. When a key is pressed, the label name for that key will be displayed to indicate that it is functioning properly. When the key is released, the message "No keys pressed" is displayed.
5. Pressing EXIT tests the EXIT key. However, the second consecutive press of EXIT aborts the test and returns the instrument to the SELF-TEST MENU. Continue pressing EXIT to back out of the menu structure.

2.4.2 DISPLAY PATTERNS Test

The display test allows you to verify that each pixel and annunciator in the vacuum fluorescent display is working properly. Perform the following steps to run the display test:

1. Display the MAIN MENU by pressing the MENU key.
2. Select TEST, and press ENTER to display the SELF-TEST MENU.
3. Select FRONT-PANEL-TESTS, and press ENTER to display the following menu:

   FRONT PANEL TESTS
   KEYS DISPLAY-PATTERNS CHAR-SET

4. Select DISPLAY-PATTERNS, and press ENTER to start the display test. There are five parts to the display test. Each time a front panel key (except EXIT) is pressed, the next part of the test sequence is selected. The five parts of the test sequence are as follows:
   A. Checkerboard pattern (alternate pixels on) and all annunciators.
   B. Checkerboard pattern and the annunciators that are on during normal operation.
   C. Horizontal lines (pixels) of the first digit are sequenced.
   D. Vertical lines (pixels) of the first digit are sequenced.
   E. Each digit (and adjacent annunciator) is sequenced. All the pixels of the selected digit are on.
5. When finished, abort the display test by pressing EXIT. The instrument returns to the SELF-TEST MENU. Continue pressing EXIT to back out of the menu structure.

2.4.3 Character set test

You can also display the character set as follows:

1. Display the MAIN MENU by pressing the MENU key.
2. Select TEST, and press ENTER to display the SELF-TEST MENU.
3. Select FRONT-PANEL-TESTS, and press ENTER to display the following menu:

   FRONT PANEL TESTS
   KEYS DISPLAY-PATTERNS CHAR-SET

4. Select CHAR-SET, and press ENTER to display the character set.
5. Press any key except EXIT to cycle through the character set displays.
6. Press EXIT to halt the test and return to the self-test menu.

2.5 Principles of operation

The following paragraphs provide a brief overview of operating principles for each major circuit section of the Model 6517. Figure 2-1 shows an overall block diagram of the instrument.

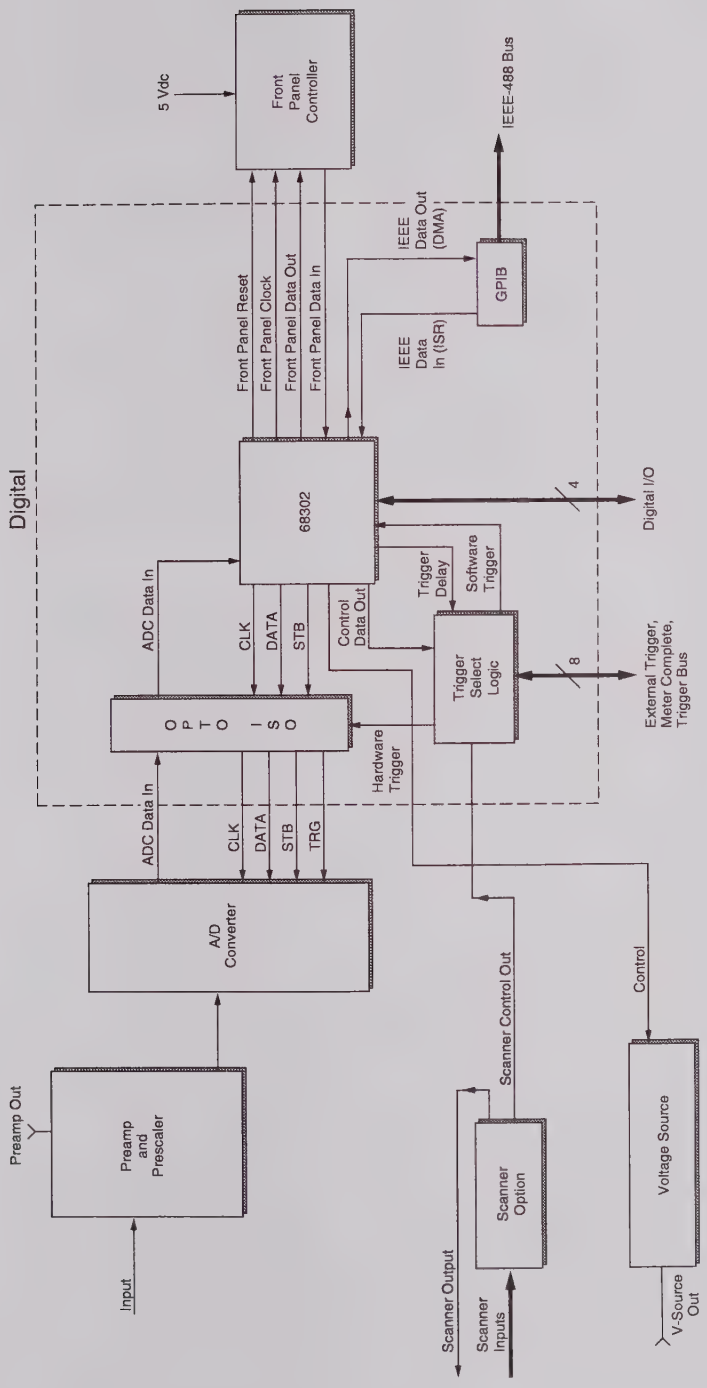


Figure 2-1
Model 6517 overall block diagram

2.5.1 Display board

The following information provides some basic circuit theory that can be used as an aid to troubleshoot the display and keyboard. Figure 2-2 shows a block diagram of the display board.

Display microcontroller

U902 is the display microcontroller that controls the VFD (vacuum fluorescent display) and interprets key data. The microcontroller has four peripheral I/O ports that are used for the various control and read functions.

Display data is serially transmitted to the microcontroller from the digital board via the TXB line to the microcontroller PD0 terminal. In a similar manner, key data is serially sent back to the digital board through the RXB line via PD1. The 4MHz clock for the microcontroller is generated on the digital board.

Vacuum fluorescent display

DS901 is the VFD (vacuum fluorescent display) module, which can display up to 49 characters. Each character is organized as a 5 x 7 matrix of dots or pixels and includes a long under-bar segment to act as a cursor.

The display uses a common multiplexing scheme with each character refreshed in sequence. U903 and U904 are the grid drivers, while U901 and U905 are the dot drivers. Note that dot driver and grid driver data is serially transmitted from the microcontroller (PD3 and PC1).

The VFD requires both +60VDC and 5VAC for the filaments. These VFD voltages are supplied by T601, which is located on the digital board.

Key matrix

The front panel keys (S901-S931) are organized into a row-column matrix to minimize the number of microcontroller peripheral lines required to read the keyboard. A key is read by strobing the columns and reading all rows for each strobed column. Key down data is interpreted by the display microcontroller and sent back to the main microprocessor using proprietary encoding schemes.

2.5.2 Power supply

The following information provides some basic circuit theory that can be used as an aide to troubleshoot the power supply. Figure 2-3 shows a block diagram of the power supply.

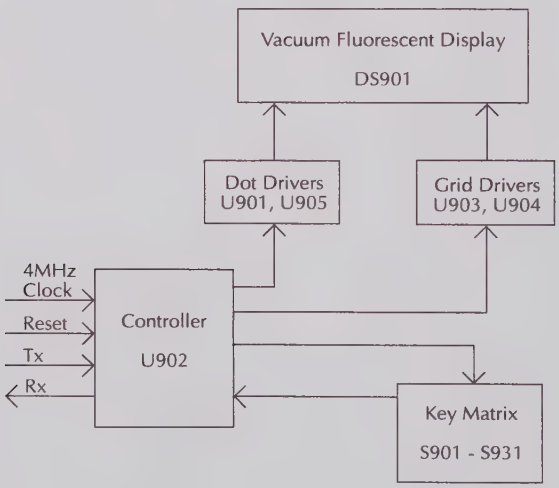


Figure 2-2
Display board block diagram

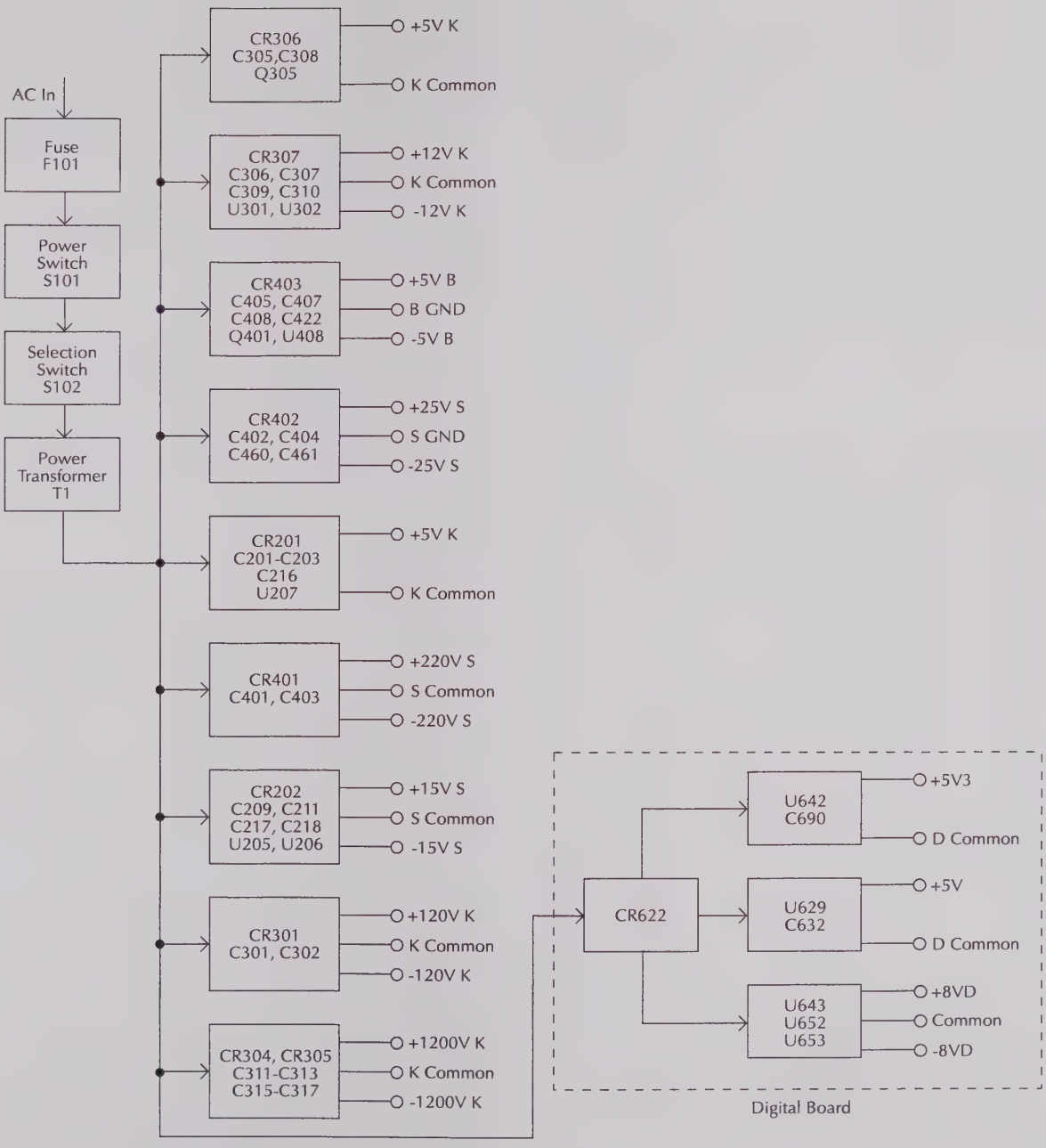


Figure 2-3
Power supply block diagram

Line power circuits

AC power is applied to the AC receptacle J1001 through the fuse F101, line switch S101, and line voltage selection switch S103 to the power transformer T1. The power transformer has a total of 10 secondary windings for the various DC supplies in the instrument.

DC circuits

Numerous DC supplies generate power for the various circuits within the instrument. Each supply uses a bridge rectifier and capacitive filter arrangement, and many supplies are regulated. Table 2-1 summarizes rectifier, filter, and regulator circuits for the various DC supplies.

Table 2-1
Power supply circuits

Supply	Rectifier	Filter	Regulator
+5VK	CR306	C305, C308	Q305
+12VK	CR307	C307, C309	U301
-12VK	CR307	C306, C310	U302
+120VK	CR301	C302	N/A
-120VK	CR301	C301	N/A
+1200VK	CR304	C311-C313	N/A
-1200VK	CR305	C315-C317	N/A
+5VB	CR403	C407, C408	U408
-5VB	CR403	C422	Q401
+25VS	CR402	C404, C461	N/A
-25VS	CR402	C402, C460	N/A
+5VS	CR201	C201-C203	U207
+220VS	CR401	C401	N/A
-220VS	CR401	C403	N/A
+15VS	CR202	C211, C217	U206
-15VS	CR202	C209, C218	U205

2.5.3 Digital board

The various sections of the digital board are discussed below. Figure 2-4 shows a block diagram of the digital board.

Microprocessor

U631 is a 68302 microprocessor that oversees all operating aspects of the instrument. The MPU has a 16-bit data bus and a 21-bit address bus, as well as parallel and serial ports for controlling various circuits. For example, the RXD1 and TXD1 lines are used for the RS-232 interface.

The MPU clock frequency of 16MHz is controlled by crystal Y602. MPU power-on reset is performed by U639, which holds the MPU RESET line low briefly on power-up.

Memory circuits

ROMs U637 and U638 store the code for instrument operation. U637 stores the D0-D7 bits of each word, and U638 stores the D8-D15 bits. Note that the digital board includes provisions for selecting between flash memory and conventional EPROMs; memory type selection is performed by jumpers W607-W610.

RAMs U635 and U636 provide temporary operating storage. U635 stores the D0-D7 bits of each data word, and U636 stores the D8-D15 bits.

Semi-permanent storage facilities include NVRAM U634 and battery backed-up RAM U640. These two ICs store such information as instrument setup and calibration constants. Note that data transmission to and from these devices is done in serial fashion. Also, U640 generates the 32.768kHz clock required to time serial data transmission with the aid of crystal Y604.

A/D converter interface

A/D converter control and data transmission is performed serially through buffer IC U614. Note that data transmission and reception is controlled by various MPU serial and parallel port lines. A/D converter communication lines include: A/D_TRIG, used to trigger the A/D; A/D_STB, used to strobe A/D control data, and A/D_DATA, which receives A/D converter counts from the A/D converter.

RS-232 interface

Serial data transmitting and receiving is performed by the TXD1 and RXD1 lines of the MPU itself.

U641 provides the necessary voltage level conversion for the RS-232 interface port.

IEEE-488 interface

U621-U623 make up the IEEE-488 interface. U622, a 9914A GPIA, takes care of routine bus overhead such as handshaking, while U621 and U623 provide the necessary buffering and drive capabilities.

Trigger and digital I/O circuits

U612 provides buffering for the digital I/O lines, while U618 provides similar functions for the trigger link, external trigger, and voltmeter complete trigger lines. In addition to buffering, U618 also has additional logic that minimizes MPU overhead necessary to control the various trigger lines.

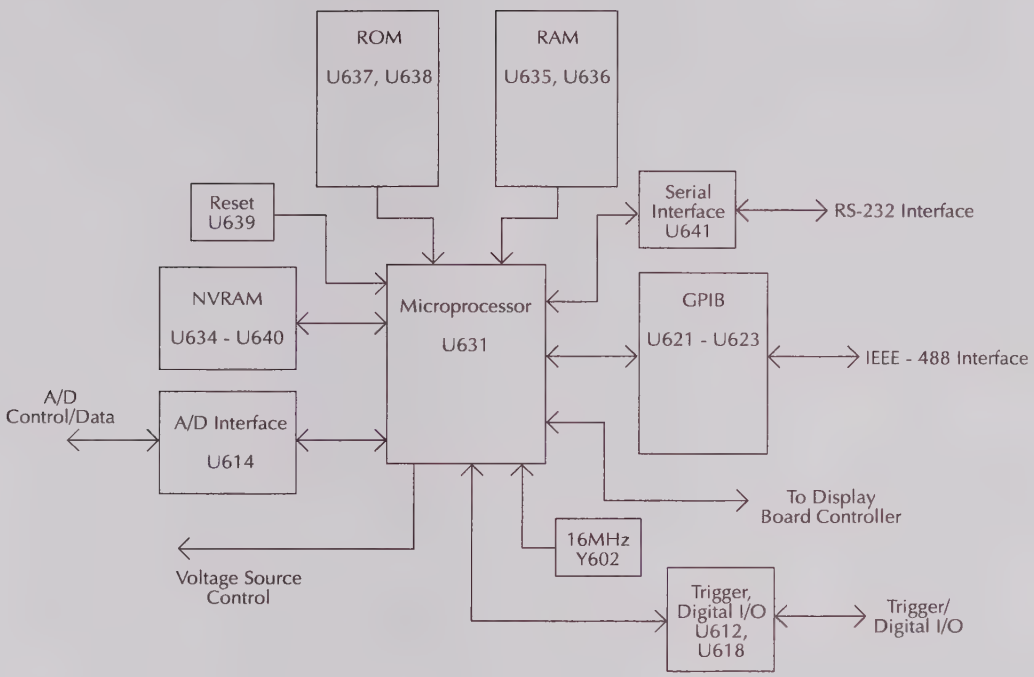


Figure 2-4
Digital board block diagram

Both the digital I/O and trigger link circuits have protection circuits to prevent damage from external circuits. CR603, CR605, CR607, and CR609 protect the digital I/O circuits, while the various trigger lines are protected by CR611-CR618, as well as by CR635-CR639 and CR642.

Power supply circuits

While most power supply circuits are located on the analog board, several supplies are located on the digital board. These include the +5V3, +5V, line frequency, and VFD power supply circuits.

AC voltage from the power transformer is rectified by CR622 and filtered by C611. U642 regulates the +5V3 supply, and U629 regulates the +5V supply. The square wave line frequency signals LINEFREQ1 and LINEFREQ2 are generated by U628 and associated components. The MO-30 power supply module generates the voltages necessary to operate the VFD located on the display board, while, U643, U652, and U653 generate the +8VD and -8VD supply voltages.

2.5.4 Analog board

Figure 2-5 is a block diagram of the analog board. Various sections of the analog board are covered below with the exception of the power supply circuits, which are covered separately paragraph 2.5.2.

Input preamplifier

The input preamplifier stage provides the high input impedance necessary for the voltage function, as well as the low input bias current and current- or charge-to-voltage conversion for the amps, ohms, and coulombs functions. The input preamplifier is essentially made up of three sections: the input stage, range/function switching, and the output stage.

The input stage is made up of U405 and associated components. This IC has the required low input bias current, and it also provides the overall gain for the input preamplifier.

The output stage includes Q402-Q413 and associated components. This stage supplies the necessary voltage and current drive capability for the input preamplifier.

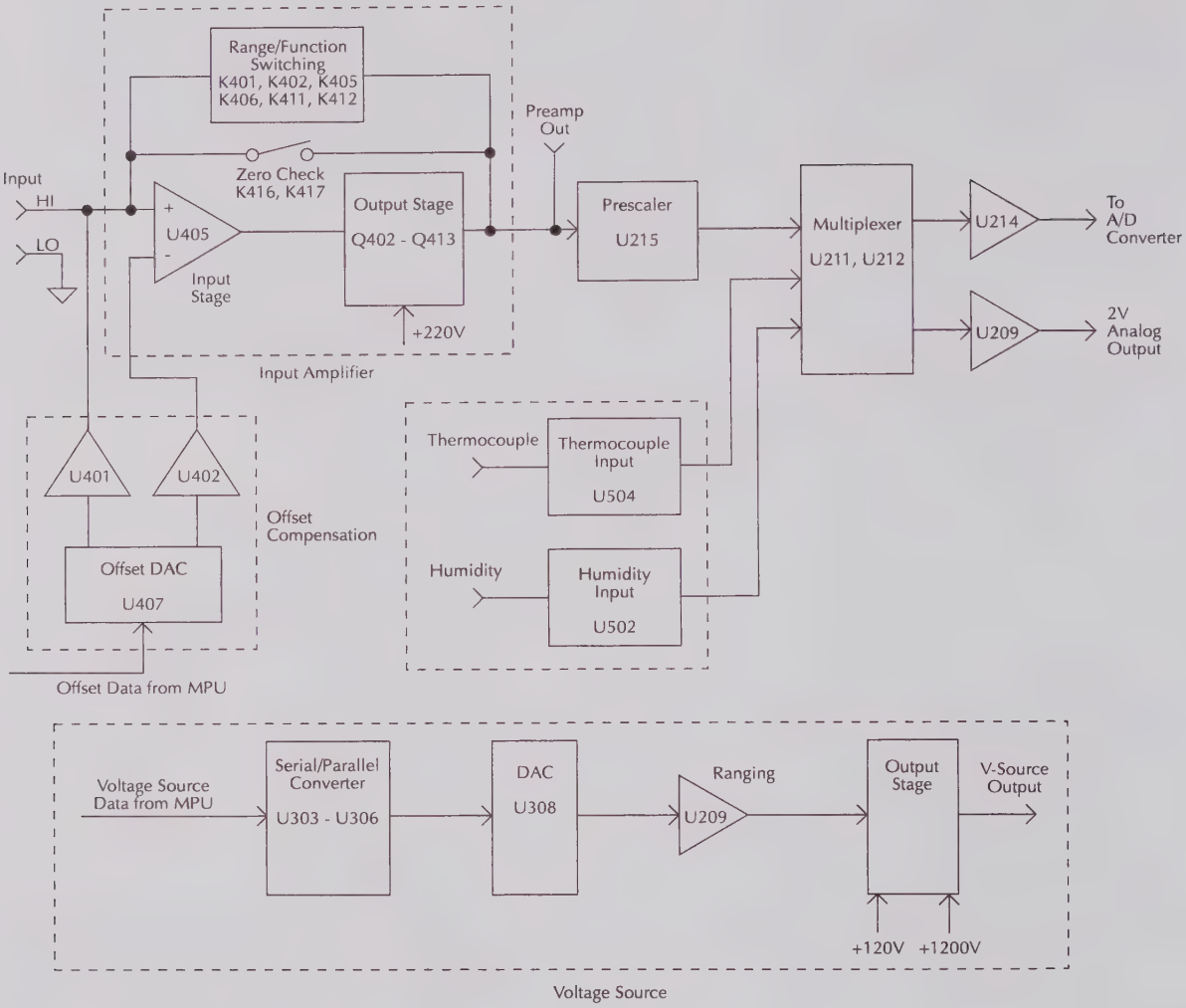


Figure 2-5
Analog board block diagram

Range/function switching is performed by various relays and associated components. These relay contacts control the circuit elements placed in the feedback path of the input preamplifier. For example, in the amps and ohms functions, appropriate feedback resistors are placed in the feedback path, while capacitors are used as the feedback element in the coulombs function. In the volts function, the preamp is configured as a unity-gain buffer by connecting its output node to the inverting input.

The input preamplifier is actually a compound operation amplifier whose exact configuration depends on the selected measuring function. As shown in Figure 2-6, the preamp is configured as a unity-gain buffer in the volts function, as an I-V converter in the amps and ohms functions, and as a Q-V converter in the coulombs function.

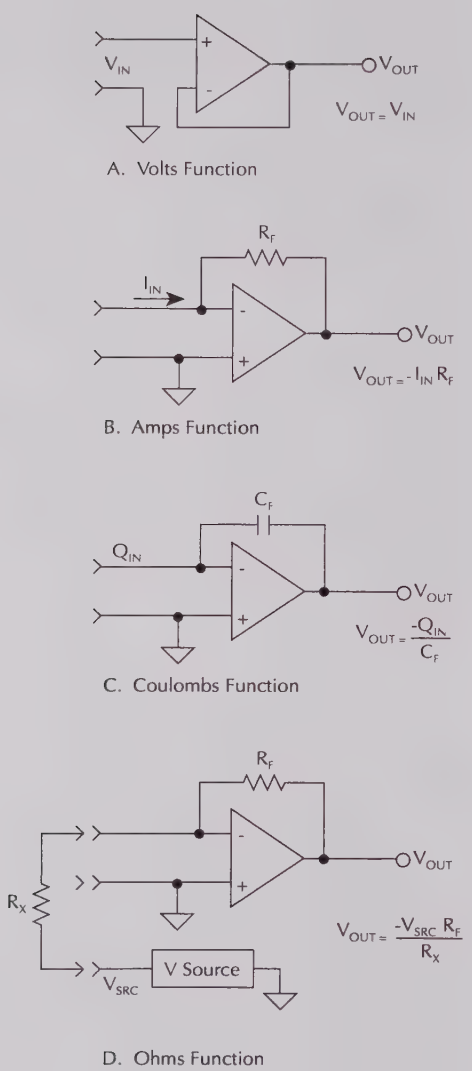


Figure 2-6
Preamp configurations

Offset compensation

Although the input preamplifier has low offset voltage and input bias current, offset compensation circuitry is included to further diminish any residual offsets. The offset compensation circuitry consists of a DAC and buffer amplifiers.

During the offset correction process, offset parameters are read by the MPU, and offset compensation constants are calculated and stored for reference. During normal operation, serial offset compensation data from the MPU is converted into parallel data by U403 and U404, and fed to a 12-bit DAC, U407. After the digital-to-analog conversion process, offset signals are buffered by U401 and U402 and applied to appropriate nodes of the preamplifier input stage to null offsets.

Prescaler

A prescaler circuit, made up of U215 and various feedback elements, selects the overall signal gain depending on selected range and function. Analog switches located in U210 and U211 select among the six feedback resistors R219-R224 to set the U215 gain factor. Prescaler absolute voltage gains of ×0.05, ×0.5, and ×5 are available depending on the pair of feedback resistors selected.

2V analog output

The 2V analog output provides a 0-2V output voltage analogous to the input signal. U209 is the 2V analog output buffer amplifier, and R214 and R215 set the absolute gain of U209 to ×0.2.

Multiplexer

Elements of U211 and U212 form the signal multiplexer that switches among the various signals to be applied to the A/D converter input. In addition to the preamp, temperature, and humidity signals, the multiplexer also switches among reference and zero signals at various phases of the measurement cycle.

A/D input buffer

The A/D input buffer U214 is the final circuit used to process the signal before it is applied to the A/D converter input. Note that the voltage gain of U214 is set to unity.

Temperature and humidity circuits

Both the temperature and humidity inputs require additional buffering and amplification. U504 and associated components provides these functions for the temperature input, while U502 and corresponding components perform similar functions for the humidity input.

Since both the temperature and humidity input voltages are referenced to digital common, special circuits are necessary to isolate the analog and digital sections. U501 and one-half of U213 provide the necessary isolation for the humidity signal, while U503 and the other half of U213 isolate the temperature signal.

Voltage source

The various voltage source circuits include the digital interface, the DAC, range control, and the power output stage. Each of these sections is briefly discussed below.

Serial voltage source control information is converted into parallel form by U303-U306. U304 is a latch that stores range and operate information, while U305 and U306 store the 16-bit data word for the voltage source output value.

The 16-bit data word that represents the voltage source value is converted into analog form by U308, a 16-bit DAC. The voltage reference for U308 is generated by regulator U309.

The voltage source itself is actually a compound operational amplifier. U307 provides the overall stage gain, while power output capabilities are supplied by Q311-Q317. Note that the ±120V supply is used to power the output stage on the 100V range, while the ±1200V supply powers the output stage on the 1000V range.

Voltage source ranging is provided by selecting feedback resistor values with elements of U312. Approximate voltage gain on the 100V range is ×20.5, while the 1000V range gain is ×207.9.

2.6 Circuit board checks

Basic troubleshooting checks for the various circuit boards are covered below.

2.6.1 Display board checks

If the FRONT PANEL TESTS (paragraph 2.4) indicate that there is a problem on the display board, use Table 2-2. Circuit theory for the display is provided in paragraph 2.5.1.

Drawing reference: Display Board; 2002-110

Table 2-2
Display board checks

Step	Item/component	Required condition	Remarks
1	FRONT PANEL TESTS	Verify that all pixels operate	Use SELF-TEST MENU selection
2	P1033, pin 5	+5V, ±5%	Digital +5V supply
3	CR902 cathode	+60V, ±10%	VFD +60V supply
4	P1033, pin 12	Goes low briefly on power-up, then goes high	Microcontroller RESET line
5	U902, pin 43	4MHz square wave	Controller 4MHz clock
6	P1033, pin 10	Pulse train every 1msec	Control from main processor
7	P1033, pin 8	Brief pulse train when front panel key pressed.	Key down data sent to main processor.

2.6.2 Power supply checks

Power supply problems can be checked out using Table 2-3.

Drawing reference: Analog Board; 6517-100

WARNING

Some power supply voltages are hazardous. Use caution to avoid electrical shock that may result in personal injury or death.

Table 2-3
Power supply checks

Step	Item/component	Required condition	Remarks
1	F101 line fuse	Check continuity	Remove to check
2	Line switch	115V/230V as required.	Line voltage selection switch.
3	Line power	Plugged into live receptacle, power on	Check for correct power up sequence.
4	Q305, pin 1	+5V, ±5%	Referenced to Common K (U301 pin 2)
5	U301, pin 1	+12V, ±5%	Referenced to Common K.
6	U302, pin 3	-12V, ±5%	Referenced to Common K.
7	+120VK (VR301 anode)	110V to 130V	Referenced to Common K.
8	-120VK (VR302 cathode)	-110V to -130V	Referenced to Common K.
9	+1200VK (VR303 anode)	1100V to 1300V	Referenced to Common K.
10	-1200VK (VR304 cathode)	-1100V to -1300V	Referenced to Common K.
11	+5VB (U408 pin 3)	+5V, ±5%	Referenced to Common B. (BGND, U408 pin 2)
12	-5VB (Q401 pin 3)	-5V, ±5%	Referenced to Common B.
13	+25VS (C461 +)	22V to 28V	Referenced to Common S. (SGND, U207 pin 2)
14	-25VS (C460 -)	-22V to -28V	Referenced to Common S.
15	+5VS (U207 pin 3)	+5V, ±5%	Referenced to Common S.
16	+220VS (C401 +)	200V to 240V	Referenced to Common S.
17	-220VS (C403 -)	-200V to -240V	Referenced to Common S.
18	+15VS (U206 pin 3)	+15V, ±5%	Referenced to Common S.
19	-15VS (U205 pin 3)	-15V, ±5%	Referenced to Common S.

2.6.3 Digital board checks

Table 2-4 summarizes checks for the digital board.

Drawing reference: Digital board; 6517-140

Table 2-4
Digital board checks

Step	Item/component	Required condition	Remarks
1	Power-on test	RAM OK, ROM OK.	Verify that RAM and ROM are functional.
2	U635 pin 16	Digital common.	All signals referenced to digital common.
3	U635 pin 32	+5V	Digital logic supply
4	U631 pin 92	Low on power-up, then goes high.	MPU RESET line.
5	U631 pins 1-24	Check for stuck bits.	MPU address bus.
6	U631 pins 31-48	Check for stuck bits.	MPU data bus.
7	U631 pin 101	16MHz clock	MPU clock
8	U639 pin 1	+3V	Backup battery voltage.
9	U640 pin 1	32.768kHz clock	Serial RAM clock.
10	U641 pin 13	Pulse train during RS-232 I/O.	RS-232 RX line.
11	U641 pin 14	Pulse train during RS-232 I/O.	RS-232 TX line.
12	U622 pins 34-42	Pulse train during IEEE-488 I/O.	IEEE-488 data bus.
13	U622 pins 26-31	Pulses during IEEE-488 I/O.	IEEE-488 command lines.
14	U622 pin 24	Low with remote enabled.	IEEE-488 REN line.
15	U622 pin 25	Low during interface clear.	IEEE-488 IFC line.
16	U614 pin 7	Pulse train.	ODATA line.
17	U614 pin 9	Pulse train.	DCLK line.
18	U614 pin 5	Pulse train.	A/D_TRIG line.
19	U614 pin 12	Pulse train.	A/D_TRIG line.
20	U614 pin 18	Pulse train.	A/D_STB line.
21	U642 pin 3	+5V, ±5%	+5V3 supply.
22	U629 pin 3	+5V, ±5%	+5V supply.
23	U628 pin 7	60Hz square wave.	LINEFREQ signal.

2.6.4 Analog board checks

Circuit checks for the analog board are summarized in Table 2-5.

Drawing reference: Analog Board; 6517-100

WARNING

Some analog board measurements concern hazardous voltages. Use caution to avoid electric shock that may result in personal injury or death.

Table 2-5
Analog board checks

Step	Item/component	Required condition	Remarks
1	Front panel controls	Volts function, 2V range, zero check off.	Initial test conditions.
2	INPUT jack	Apply +2.0000V DC	Input test voltage.
3	PREAMP OUT	+2V	Referenced to COMMON.
4	U215 pin 6	-10V	Referenced to COMMON.
5	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
6	Front panel controls	Volts function, 20V range, zero check off.	Initial test conditions.
7	INPUT jack	Apply +20.0000V DC	Input test voltage.
8	PREAMP OUT	+20V	Referenced to COMMON.
9	U215 pin 6	-10V	Referenced to COMMON.
10	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
11	Front panel controls	Volts function, 200V range, zero check off.	Initial test conditions.
12	INPUT jack	Apply +200.0000V DC	Input test voltage.
13	PREAMP OUT	+200V	Referenced to COMMON.
14	U215 pin 6	-10V	Referenced to COMMON.
15	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
16	Front panel controls	Amps function, 20pA range, zero check off.	Initial test conditions.
17	INPUT jack	Apply +20.0000pA DC	Input test current.
18	PREAMP OUT	+20V	Referenced to COMMON.
19	U215 pin 6	-10V	Referenced to COMMON.
20	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
21	Front panel controls	Amps function, 20nA range, zero check off.	Initial test conditions.
22	INPUT jack	Apply +20.0000nA DC	Input test current.
23	PREAMP OUT	+20V	Referenced to COMMON.
24	U215 pin 6	-10V	Referenced to COMMON.
25	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
26	Front panel controls	Amps function, 20μA range, zero check off.	Initial test conditions.
27	INPUT jack	Apply +20.0000μA DC	Input test current.
28	PREAMP OUT	+20V	Referenced to COMMON.
29	U215 pin 6	-10V	Referenced to COMMON.
30	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
31	Front panel controls	Amps function, 20mA range, zero check off.	Initial test conditions.
32	INPUT jack	Apply +20.0000mA DC	Input test current.
33	PREAMP OUT	+20V	Referenced to COMMON.
34	U215 pin 6	-10V	Referenced to COMMON.
35	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
36	Front panel controls	Coulombs function, 2nC range, zero check off.	Initial test conditions.
37	INPUT jack	Apply 2nC charge.	Input test charge.
38	PREAMP OUT	+20V	Referenced to COMMON.
39	U215 pin 6	-10V	Referenced to COMMON.

Table 2-5 (cont.)
Analog board checks

Step	Item/component	Required condition	Remarks
40	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
41	Front panel controls	Coulombs function, 20nC range, zero check off.	Initial test conditions.
42	INPUT jack	Apply 20nC charge.	Input test charge.
43	PREAMP OUT	+20V	Referenced to COMMON.
44	U215 pin 6	-10V	Referenced to COMMON.
45	2V ANALOG OUTPUT	+2V	Referenced to COMMON.
46	Front panel controls	Set voltage source to 100V, operate on.	Program voltage source.
47	U308 pin 4	4.88V	Referenced to V SOURCE LO.
48	V SOURCE HI	100V	Referenced to V SOURCE LO.
49	Front panel controls	Set voltage source to 100V, operate on.	Program voltage source.
50	U308 pin 4	4.81V	Referenced to V SOURCE LO.
51	V SOURCE HI	1000V	Referenced to V SOURCE LO.
52	Q311 drain	+1200V	Referenced to V SOURCE LO.
53	CR302 cathode	+120V	Referenced to V SOURCE LO.
54	VR311 anode	-1200V	Referenced to V SOURCE LO.
55	CR308 cathode	-120V	Referenced to V SOURCE LO.

3
Disassembly

3.1 Introduction

The information in this section explains how to disassemble the Model 6517. Also discussed are handling and cleaning considerations as well as the procedure to change the main CPU firmware in the event of an upgrade.

WARNING

The information in this section is intended only for qualified service personnel. Some of these procedures may expose you to hazardous conditions. Do not attempt these procedures unless you are qualified to do so.

This section is organized as follows:

3.2 **Handling and cleaning precautions:** Covers general precautions to take when troubleshooting inside the unit, and cleaning procedures when replacing parts.

3.3 **Static-sensitive devices:** Explains handling procedures for static-sensitive devices.

3.4 **Case cover removal:** Explains how to remove the case cover.

3.5 **PC-board removal:** Provides the procedures for removing the digital board, A/D converter board, and the analog board.

3.6 **Front panel disassembly:** Explains how to remove the display board.

3.7 **Firmware replacement:** Provides the procedure to change firmware.

3.8 **Instrument re-assembly:** Provides some general guidelines to follow when re-assembling the Model 6517.

3.9 **Assembly drawings:** Provides mechanical drawings to assist in the disassembly and re-assembly of the Model 6517.

3.2 Handling and cleaning precautions

When servicing the instrument, care should be taken not to indiscriminately touch PC board traces to avoid contaminating them with body oils or other foreign matter. Analog board areas covered by the shield have high-impedance devices or sensitive circuitry where contamination could cause degraded performance.

3.2.1 PC-board handling

Observe the following precautions when handling PC-boards:

- Wear clean cotton gloves.
- Handle PC-boards only by the edges and shields.
- Do not touch any board traces or components not associated with the repair.
- Do not touch areas adjacent to electrical contacts.
- Use dry nitrogen gas to clean dust off PC-boards.

3.2.2 Solder repairs

Observe the following precautions when it is necessary to use solder on a circuit board:

- Use an OA-based (non-acid) flux, and take care not to spread the flux to other areas of the circuit board.
- Remove the flux from the work areas when the repair has been completed. Use pure water along with clean foam-tipped swabs or a clean soft brush to remove the flux. Be sure not to wash contaminated flux or water over other PC board areas.
- Once the flux has been removed, swab only the repaired area with methanol, then blow dry the board with dry nitrogen gas.
- After cleaning, the board should be allowed to dry in a 50°C low-humidity environment for several hours.

3.3 Special handling of static-sensitive devices

CMOS devices operate at very high impedance levels for low power consumption. As a result, any static that builds up on your person or clothing may be sufficient to destroy these devices, if they are not handled properly. Use the following precautions to avoid damaging them:

CAUTION

Many CMOS devices are installed in the Model 6517. In general, it is recommended that all semiconductor devices be handled as being static-sensitive.

1. ICs should be transported and handled only in containers specially designed to prevent static build-up. Typically, these parts will be received in anti-static containers of plastic or foam. Keep these devices in their original containers until ready for installation.
2. Remove the devices from their protective containers only at a properly grounded work station. Also, ground yourself with a suitable wrist strap.
3. Handle the devices only by the body; do not touch the pins.
4. Any printed circuit board into which the device is to be inserted must also be grounded to the bench or table.
5. Use only anti-static type solder sucker.
6. Use only grounded tip solder irons.
7. Once the device is installed in the PC board, it is usually adequately protected, and normal handling can resume.

3.4 Case cover removal

If it is necessary to troubleshoot the instrument or to replace a component, use the following procedure to remove the case cover.

WARNING

Before removing the case cover, disconnect the line cord and any connecting cables and wires from the instrument. Allow sufficient time for capacitors to discharge before disconnecting cables or removing the cover.

To remove the case cover, refer to drawing 6517-057 (at the end of this section), and perform the following steps:

1. Remove handle: The handle serves as an adjustable tilt-bail. Its position is adjusted by gently pulling it away from the sides of the instrument case and swinging it up or down. To remove the handle, swing the handle below the bottom surface of the case and back until the orientation arrows on the handles line up with the orientation arrows on the mounting ears. With the arrows lined up, pull the ends of the handle out of the case.
2. Remove mounting ears: Each mounting ear is secured to the chassis with a single screw. Remove the two screws, and pull down and out on each mounting ear. Note: When re-installing the mounting ears, make sure to mount the right ear to the right side of the chassis, and the left ear to the left side of the chassis. Each ear is marked "RIGHT" or "LEFT" on its inside surface.
3. Remove rear bezel: The rear bezel is secured to the chassis by two screws. To remove the rear bezel, loosen the two screws, and pull the bezel away from the case.
4. Remove grounding screw: Remove the grounding screw for the case cover. This screw is located on the bottom side of the instrument at the rear.
5. Remove chassis: Grasp the front bezel of the instrument, and carefully slide the chassis forward out of the metal case.

The internal PC-board assemblies are now accessible.

3.5 PC-board removal

There are three PC-boards mounted in the chassis: the digital board, the analog board, and the A/D converter board, which is mounted on the analog board. The removal of these three boards is covered below. The display board is mounted in the

front panel assembly. The removal of the display board is covered in paragraph 3.6.

Any one of the PC-boards can be removed without having to remove any of the other boards. Note that the A/D converter board plugs into the analog board and can be left installed when removing the analog board.

NOTE

Before performing any of the following procedures to remove a PC-board, remove the case cover as explained in paragraph 3.4.

3.5.1 Digital board removal

The digital board is removed through the bottom of the chassis (see drawing 6517-053). Note that the power switch pushrod need not be removed in order to remove the digital board.

Perform the following steps to remove the digital board:

1. Unplug cables: Turn the chassis upside-down and unplug the following cables from the digital board:
   A. Unplug the display board ribbon cable from connector J1033.
   B. Unplug the transformer cable from connector J1032.
   C. Unplug the analog board ribbon cable from connector J1029. This cable connection is located under the power switch pushrod.
   D. Unplug the interlock cable from connector J1030. This four-conductor cable connection is located at the rear of the digital board in front of the IEEE-488 connector.
2. Unfasten PC-board: Remove the following items to unfasten the digital board from the chassis:
   A. At the rear panel, remove the nuts that secure the IEEE-488 and RS-232 connectors to the chassis.
   B. Remove the clip that secures regulators U629 and U642 to the chassis. This clip is located adjacent to the pushrod near the front panel.
   C. Remove the three screws that secure the digital board to the chassis. One screw is located at the rear of the digital board near the interlock connector, and the other two screws are located near the connector for the option slot.
3. Remove digital board: The board is held in place by edge guides on each side. Slide the digital board forward until the board edges clear the guides, and then carefully pull the board out of the chassis.

3.5.2 A/D converter board removal

The A/D converter board is located under the A/D Board shield on the analog board (see drawing 6517-050).

Perform the following steps to remove the A/D converter board:

1. Remove A/D board shield: Position the chassis right-side-up. The A/D board shield is secured to the analog board by two screws. To remove the shield, simply remove the screws, and carefully lift the shield away from the A/D converter board.
2. Remove A/D converter board: The A/D converter board is located near the front of the instrument and is plugged into the analog board at connector J1026. The board rests on three stand-offs, one of which has a retaining clip to hold the board securely in place. Gently pull the retaining clip away, and lift the board up until it clears the clip. With the board clear of the retaining clip, unplug the board, and pull it out of the chassis.

3.5.3 Analog board removal

The analog board is removed through the top of the chassis (see drawing 6517-053). Perform the following steps to remove the analog board:

1. Remove analog top shield: The top shield is secured to the analog board by a single screw. To remove the top shield, simply loosen the screw, and carefully lift the shield out of the chassis.
2. Remove pushrod: Remove the pushrod for the POWER switch as follows:
   A. Turn the chassis upside-down. Grasp the rear end of the POWER pushrod, and pull upward until it disengages from the switch shaft. Remove the pushrod from the chassis.
   B. Return the chassis to the up-right position.
3. Remove power transformer: Remove the power transformer (see drawing 6517-054) as follows:
   A. Disconnect the transformer ground. A kep nut is used to connect this green ground wire to a threaded stud on the chassis.
   B. Unplug the transformer. There are five plugs for the transformer. Four are located on the analog board at connectors J1024, J1025, J1027, and J1028, and the fifth is located on the digital board at connector J1032. Turn the chassis upside-down to gain access to the plug on the digital board. When finished, return the chassis to the up-right position.

C. The transformer is secured to the bottom of the chassis by four screws. Remove these screws, and pull the transformer out of the chassis.

4. Remove AC power receptacle: Remove the AC power receptacle as follows:
   A. Disconnect the receptacle ground wire. A kep nut is used to connect this green ground wire to a threaded stud on the chassis.
   B. Unplug the AC power receptacle cable. The connector for this cable is located on the analog board next to the power receptacle.
   C. A spring clip on each side of the receptacle is used to secure it to the rear panel of the chassis. To remove it, press both clips inward and, at the same time, push the receptacle out of the access hole in the rear panel of the chassis.
5. Unplug cable to digital board: On the left side of the analog board there is a ribbon cable going to the digital board. Turn the chassis upside-down, and unplug this cable at connector J1029 on the digital board. Return the chassis to the right-side-up position.
6. Disconnect input/output cables: Disconnect the following cables from the analog board:
   A. INPUT cable at J1019 and J1020.
   B. V SOURCE cable at J1022.
   C. PREAMP OUT, COMMON, and 2V OUTPUT cable at J1021.
7. Unfasten analog board: The analog board is secured to the chassis at the rear panel by the two BNC connectors (External Trigger and Meter Complete). At the rear panel, remove the nuts and lock washers for the BNC connectors. Also remove the two screws that secure the board to the chassis.
8. Remove analog board: The board is held in place by edge guides on each side of the chassis. Slide the analog board forward until the board edges clear the guides, and then carefully lift the board out of the chassis. The bottom shield on the analog board can be removed by simply pulling it off the board.

3.6 Front panel disassembly

Use the following disassembly procedure to remove the display board and/or the pushbutton switch pad. Drawing 6517-054 shows how the front panel separates from the chassis, and drawing 6517-040 shows an exploded view of the front panel assembly.

NOTE

Before performing the following procedure to remove and disassemble the front panel, remove the case cover as explained in paragraph 3.4.

Perform the following steps to remove and disassemble the front panel:

1. Unplug display cable: Turn the chassis upside-down, and unplug the display cable from the digital board at connector J1033.
2. Remove front panel assembly: The front panel assembly has four retaining clips that snap onto the chassis over four pem nut studs. Two retaining clips are located on each side of the front panel. Pull the retaining clips outward and, at the same time, pull the front panel assembly forward until it separates from the chassis.
3. Remove display board: The display board is held in place by a PC board stop. This stop is simply a plastic bar that runs along the bottom edge of the display board. Using a thin bladed screwdriver, pry the plastic bar upward until it separates from the casing of the front panel. Pull the display board out of the front panel.
4. Remove switch pad: The conductive rubber switch pad simply pulls out of the front panel.

3.7 Main CPU firmware replacement

Changing the firmware may be necessary as upgrades become available. The firmware revision level for the main CPU is displayed during the power-on sequence. The firmware for the main CPU is located in two ROMs (U637 and U638) located on the digital board. (See the digital board component layout drawing 6517-140 at the end of Section 4.)

Perform the following steps to replace the CPU firmware:

WARNING

Disconnect the instrument from the power line, and disconnect all cables and test leads before changing the firmware.

1. Remove the case cover as explained in paragraph 3.4.
2. Turn the instrument upside down to gain access to the digital board.
3. Locate U637 and U638 (ROMs) on the digital board. These two ICs are located near the center of the PC board next to the power transformer.

CAUTION

U637 and U638 are static-sensitive devices. Be sure to adhere to the handling precautions explained in paragraph 3.3 when replacing these devices.

4. Using an appropriate chip extractor, remove U637 and U638 from their sockets.
5. Install the new ROMs in the appropriate sockets, making sure that pin 1 for each device is properly oriented.

NOTE

The odd-addressed ROM must be installed at U637, and the even-addressed ROM must be installed at U638. The instrument will not operate if the ROMs are incorrectly installed.

3.8 Instrument re-assembly

The instrument can be re-assembled by reversing the previous disassembly procedures. Make sure that all parts are properly seated and secured, and that all connections are properly made. To ensure proper operation, shields must be replaced and fastened securely.

WARNING

To ensure continued protection against electric shock, verify that power line ground (green wire attached to AC power receptacle) and the power transformer ground are connected to the chassis. Also make sure that the external ground screw is properly secured after installing the case cover.

3.9 Assembly drawings

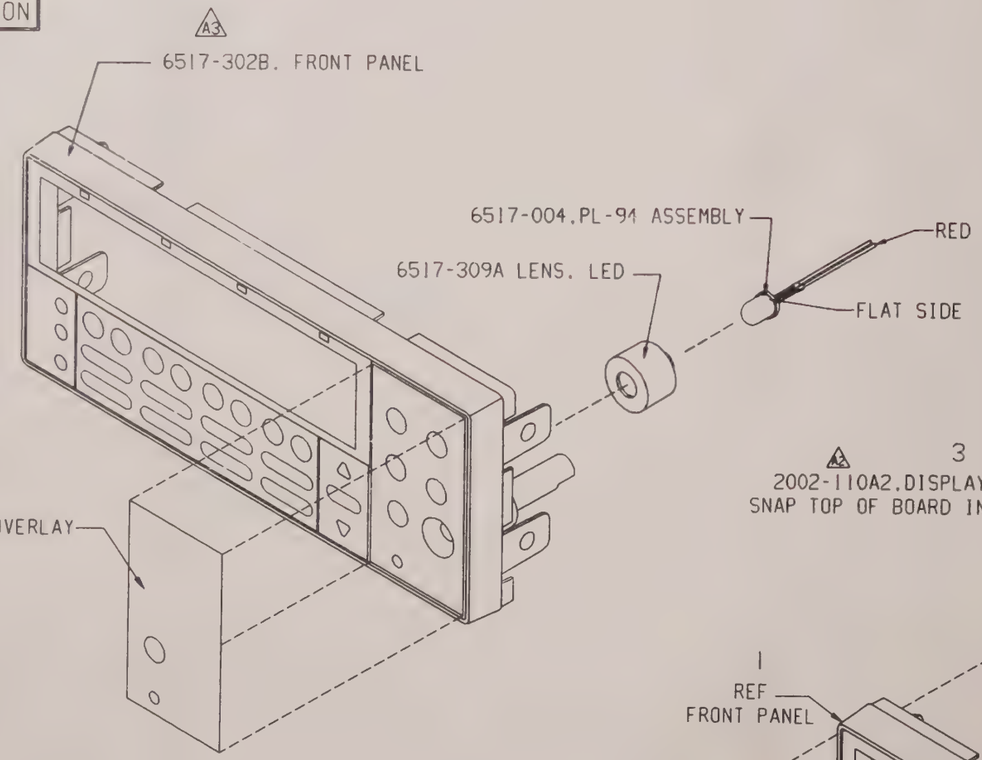
The following assembly drawings are provided to assist in disassembly and re-assembly of the instrument. Also, the Keithley part numbers for most mechanical parts are provided in these drawings.

- Front Panel Assembly; 6517-040
- Analog Shield Assembly; 6517-050
- Chassis Assembly; 6517-051
- Rear Panel Assembly; 6517-052
- Chassis Assembly (Analog Side); 6517-053
- Chassis Assembly (Front Panel and Transformer Mounting); 6517-054
- Chassis Assembly (Digital Side); 6517-055
- Chassis Assembly (Case and Handle); 6517-057

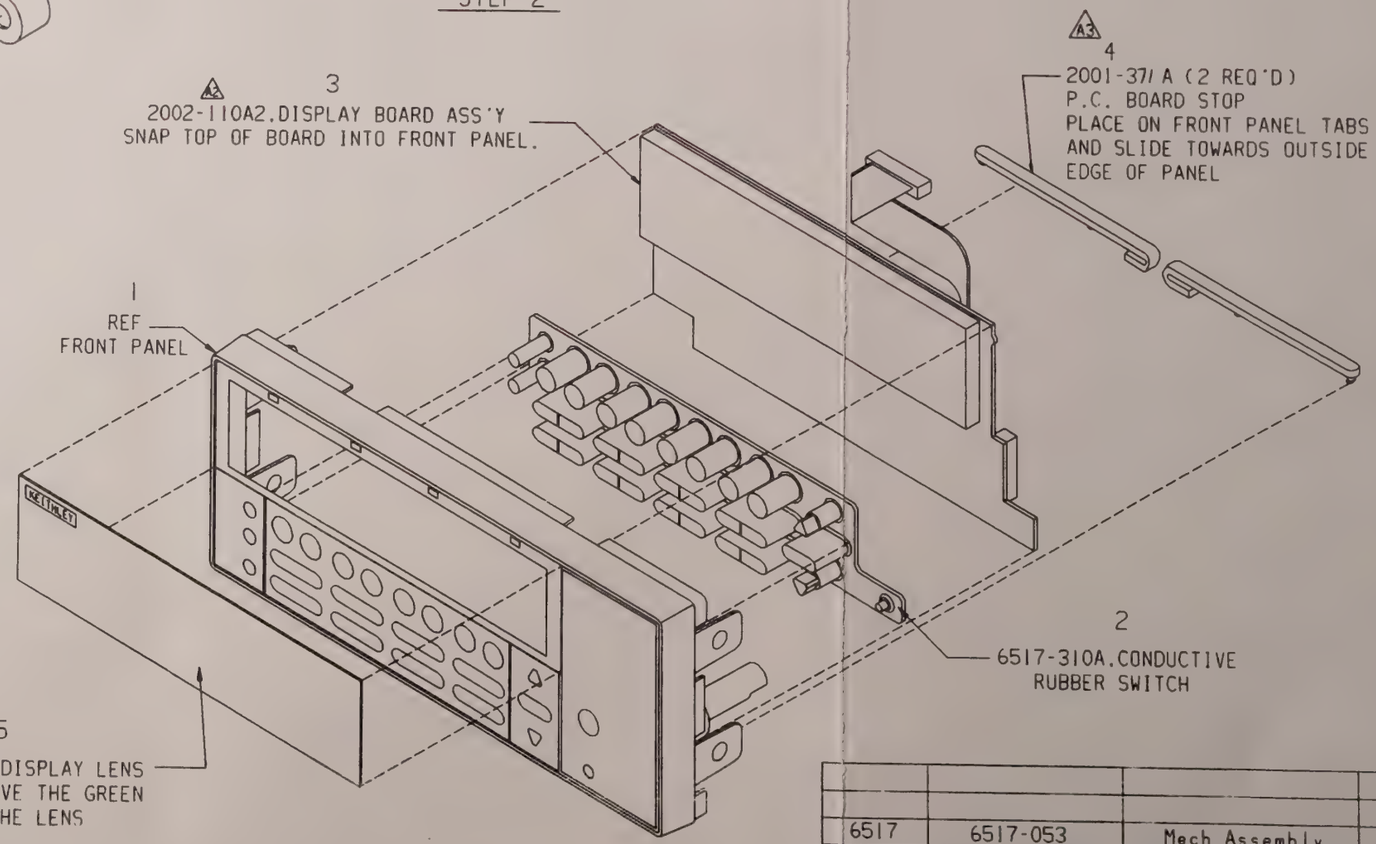
NO. 6517-040

LTR	ECA NO.	REVISION	ENG	DATE
A	940713	RELEASED	ST	7/13/94
A1	16610	6517-307B WAS 6517-307A	ST	9/29/94
A2	16924	2002-110A2 WAS 2002-110A	ST	1/24/95
A3	17073	6517-302B Was 6517-302A; 2001-371A Was 2001-335D		

STEP 1



STEP 2



PART NO.	QTY	DESCRIPTION
6517-302B	1	FRONT PANEL A3
2002-110A2	1	DISPLAY BOARD ASS'Y A2
6517-312A	1	OVERLAY
6517-307B	1	DISPLAY LENS A1
6517-310A	1	CONDUCTIVE RUBBER SWITCH
2001-371A	2	P.C. BD STOP A3
6517-309A	1	LENS, LED
6517-004	1	CRIMP ASSEMBLY

6517	6517-053	Mech Assembly	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY

USED ON

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KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED		DATE 5/5/94	SCALE X
XX ± .015	ANG ± 1°	DRN Mat	ENG APPR LS
XXX ± .005	FRAC ± 1/64	MATERIAL X	
SURFACE MAX 63		FINISH X	

TITLE: FRONT PANEL ASSEMBLY OP8

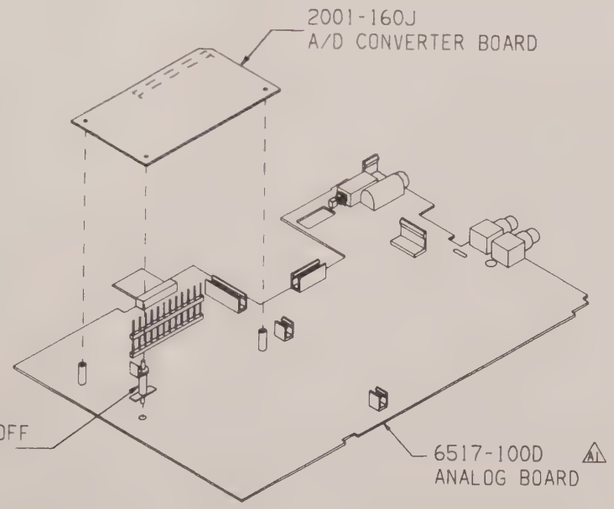
B

NO. 6517-040

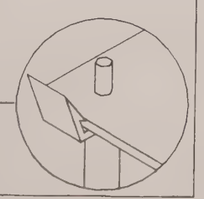
LTR	ECA NO.	REVISION	ENG	DATE
A	940713	RELEASED	ST	7/13/94
A1	16744	6517-100D WAS 6517-100C	[illegible]	[illegible]

NO. 6517-050

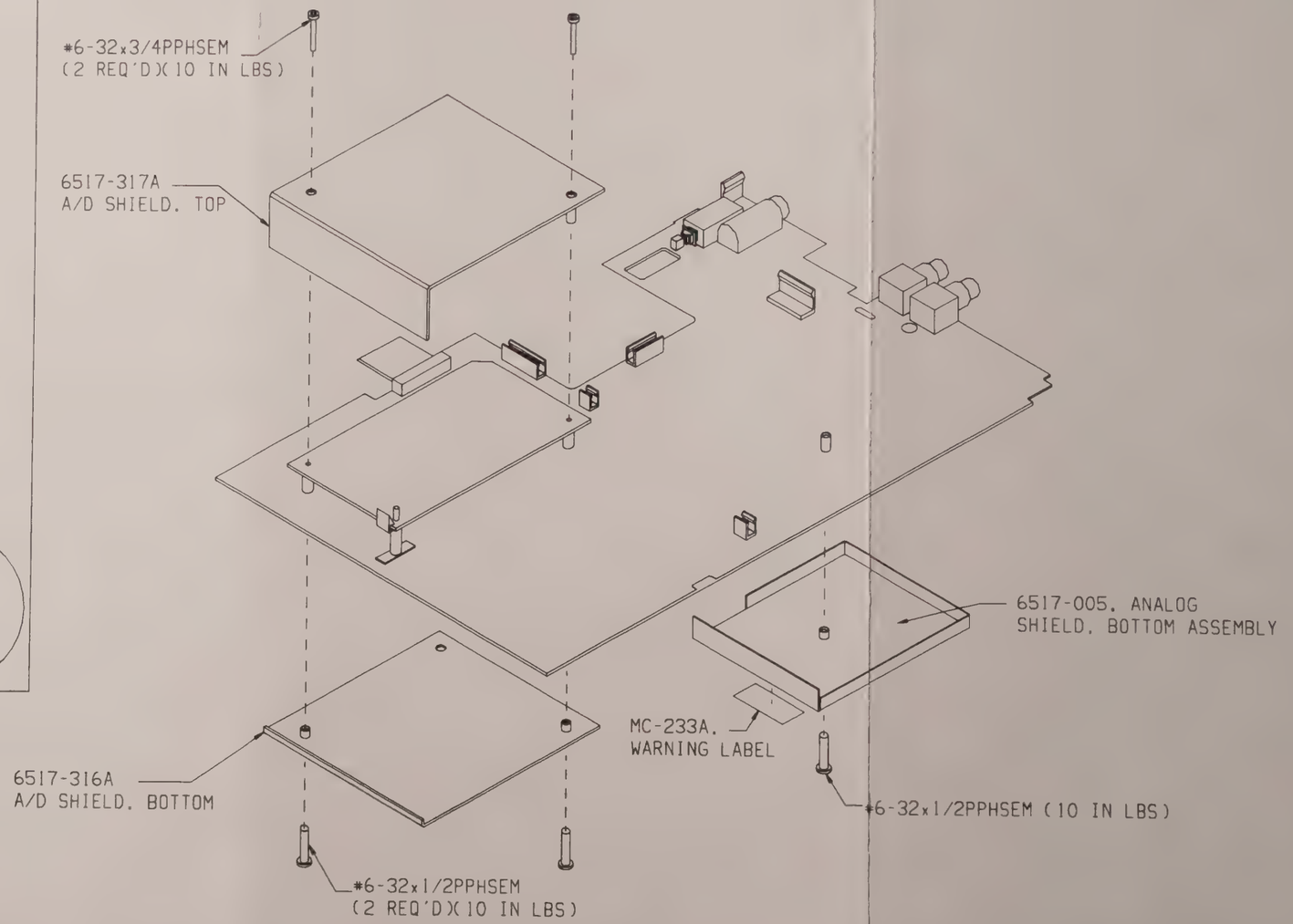
STEP 1



REQUIRED PROCESS:
ST-202-1. STANDOFF. MUST REMAIN IN SEALED PLASTIC BAG UNTIL INSERTION INTO ANALOG BOARD ASSEMBLY. (PARTS CAN DRY AND TURN BRITTLE.)
PRESS A/D BOARD INTO ST-202-1 WITH PRESSURE APPLIED AT CORNER OF P.C. BOARD ONLY. TAB MUST NOT BE BENT BACK MORE THAN IS NECESSARY TO CLEAR P.C. BOARD.



STEP 2



PART NO.	QTY	DESCRIPTION
6517-100D	1	ANALOG BOARD ⚠1
2001-160J	1	A/D CONVERTER BOARD
6517-316A	1	A/D SHIELD. BOTTOM
6517-317A	1	A/D SHIELD. TOP
6517-005	1	ANALOG BOTTOM SHIELD ASSEMBLY
MC-233A	1	LABEL. WARNING
ST-202-1	1	STANDOFF. EDGE HOLDING
#6-32x3/4PPHSEM	2	PHIL PAN HEAD SEMS SCREW
#6-32x1/2PPHSEM	3	PHIL PAN HEAD SEMS SCREW

MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
6517	6517-052	Chassis Assembly	1

USED ON

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ±.015 ANG = ±1°
XXX = ±.005 FRAC = ±1/64
SURFACE MAX 63

DATE 5/6/94 SCALE ℄
DRN Mat ENG APPR LS
MATERIAL ℄
FINISH ℄

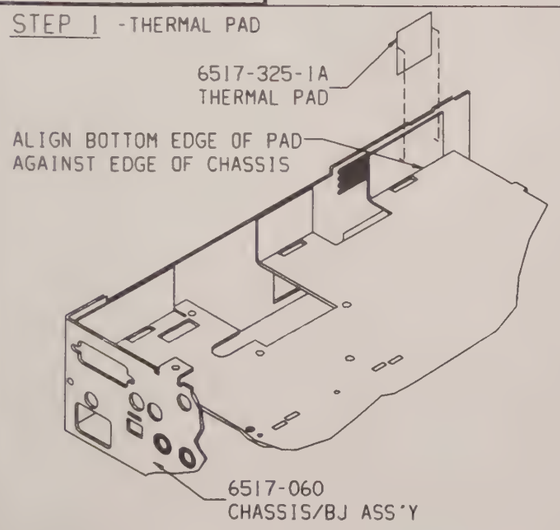
TITLE
ANALOG SHIELD ASSEMBLY - OP8

B NO. 6517-050

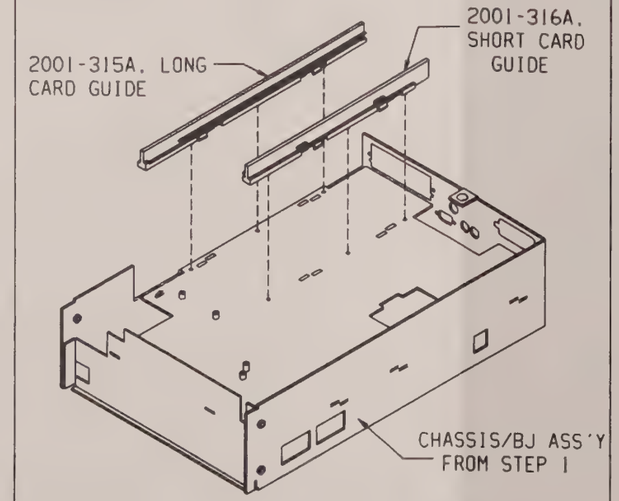
SN 6517-051 ON

LTR	ECA NO.	REVISION	ENG	DATE
A	940713	Released	SA	7/13/94

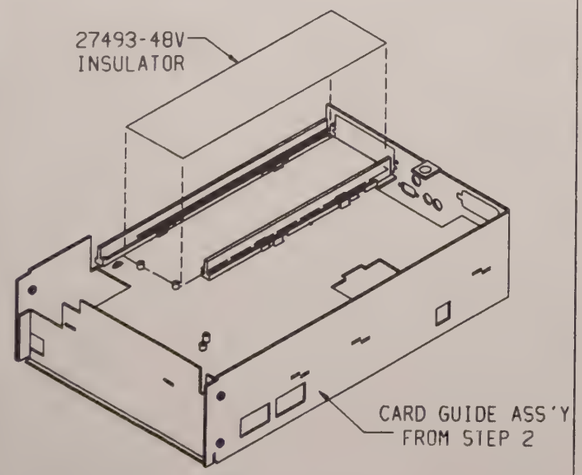
STEP 1 -THERMAL PAD



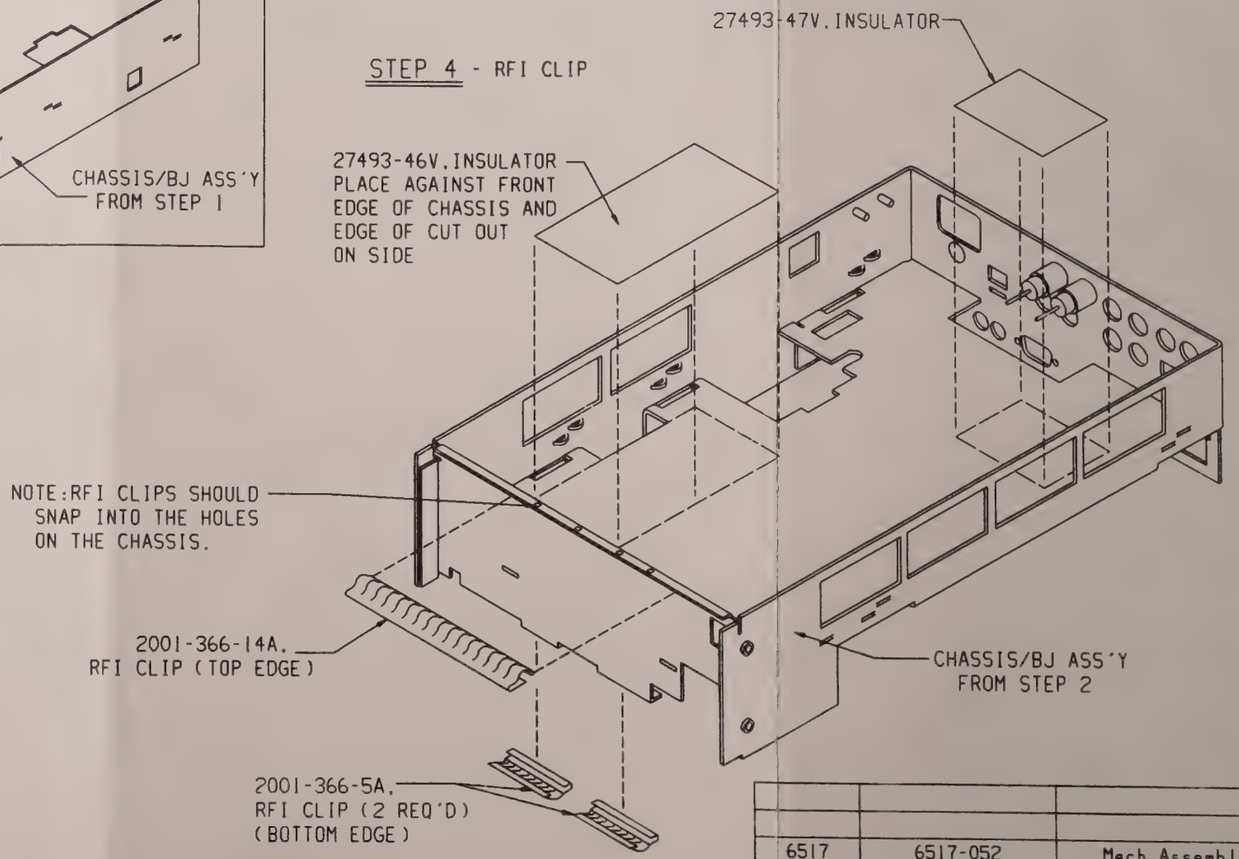
STEP 2 -CARD GUIDE ASS'Y



STEP 3 -INSULATOR ASS'Y



STEP 4 - RFI CLIP



PART NO.	QTY	DESCRIPTION
6517-060	1	CHASSIS/BJ ASS'Y
2001-315A	1	CARD GUIDE, LONG
2001-316A	1	CARD GUIDE, SHORT
2001-366-5A	2	RFI CLIP
2001-366-14A	1	RFI CLIP
6517-325-1A	1	THERMAL PAD
27493-46V	1	INSULATOR
27493-47V	1	INSULATOR
27493-48V	1	INSULATOR

6517	6517-052	Mech Assembly	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
USED ON			

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX ± .015 ANG ± 1°
XXX ± .005 FRAC ± 1/64
SURFACE MAX 63

DATE 5/11/94 SCALE X
DRN Mat ENG APPR
MATERIAL X
FINISH X

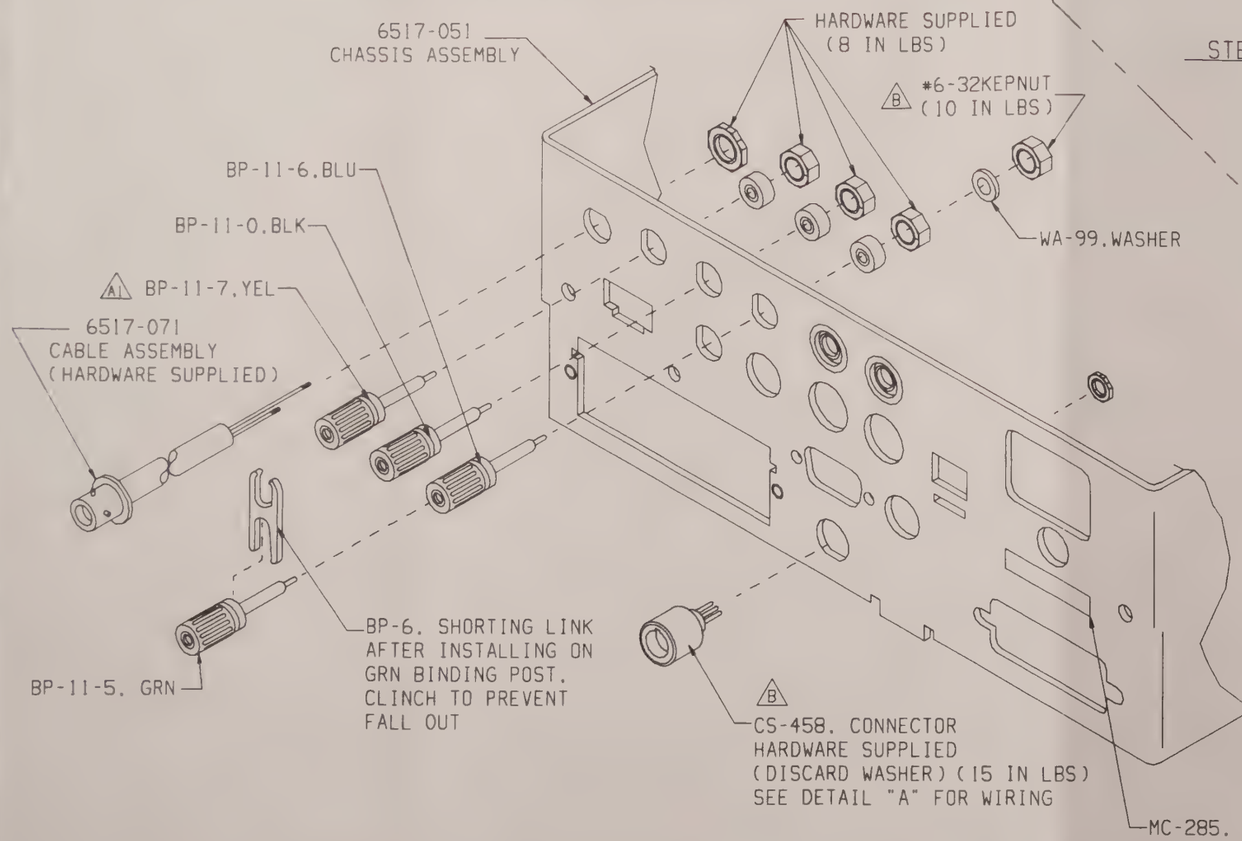
TITLE
CHASSIS ASSEMBLY

B NO. 6517-051

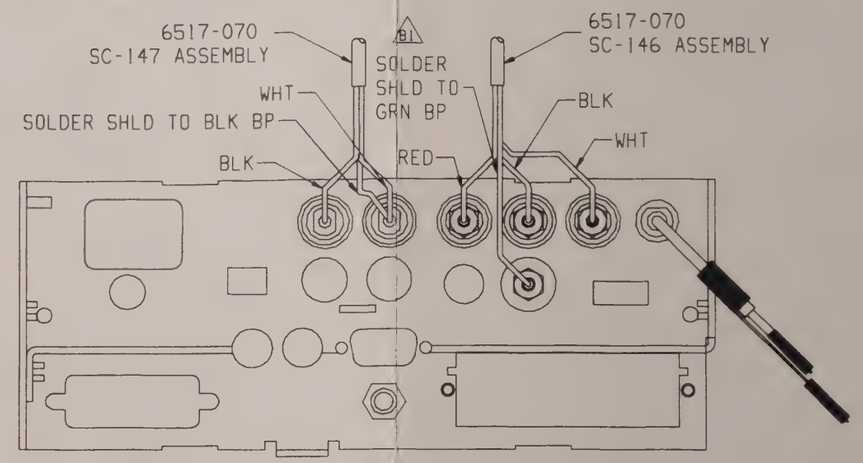
NO. 6517-052

LTR	ECA NO.	REVISION	ENG	DATE
A1	16668	DEL.(1) BP-11-6; ADDED (1) BP-11-7	ST	8/5/94
B	16756	ADDED: KEPNUT CALLOUT; TORQUE SPEC	ST	10/4/94
B1	16744	SOLDER SHLD TO GRN BP WAS SOLDER SHLD TO BLK BP.	ST	11/1/94

STEP 1 - REAR PANEL ASSEMBLY



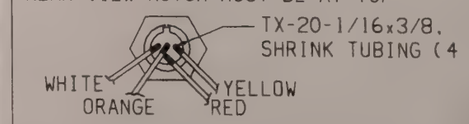
STEP 2 - REAR PANEL WIRING



PART NUMBER	QTY	DESCRIPTION
6517-004	1	WIRE CRIMP
6517-070	1	CABLE ASSEMBLY
6517-071	1	CABLE ASSEMBLY
6517-051	1	CHASSIS ASSEMBLY
BP-11-0	1	BINDING POST. BLK
BP-11-5	1	BINDING POST. GRN
BP-11-6	1	BINDING POST. BLU
BP-11-7	1	BINDING POST. YEL A1
BP-6	1	SHORTING LINK
CS-458	1	CONNECTOR
MC-285	1	SERIAL NUMBER
TX-20-1/16x3/8	4	SHRINK TUBING
WA-99	1	WASHER
#6-32KEPNUT	1	KEPNUT B

DETAIL A

WIRE CONNECTOR BEFORE INSTALLING TO PANEL
CS-458.CONNECTOR
REAR VIEW NOTCH MUST BE AT TOP



6517-004.CS-638-4. ASSEMBLY

MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
6517	6517-053	Chassis Ass'y -- Analog	1

USED ON

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ±.015 ANG = ±1°
XXX = ±.005 FRAC = ±1/64
SURFACE MAX 63

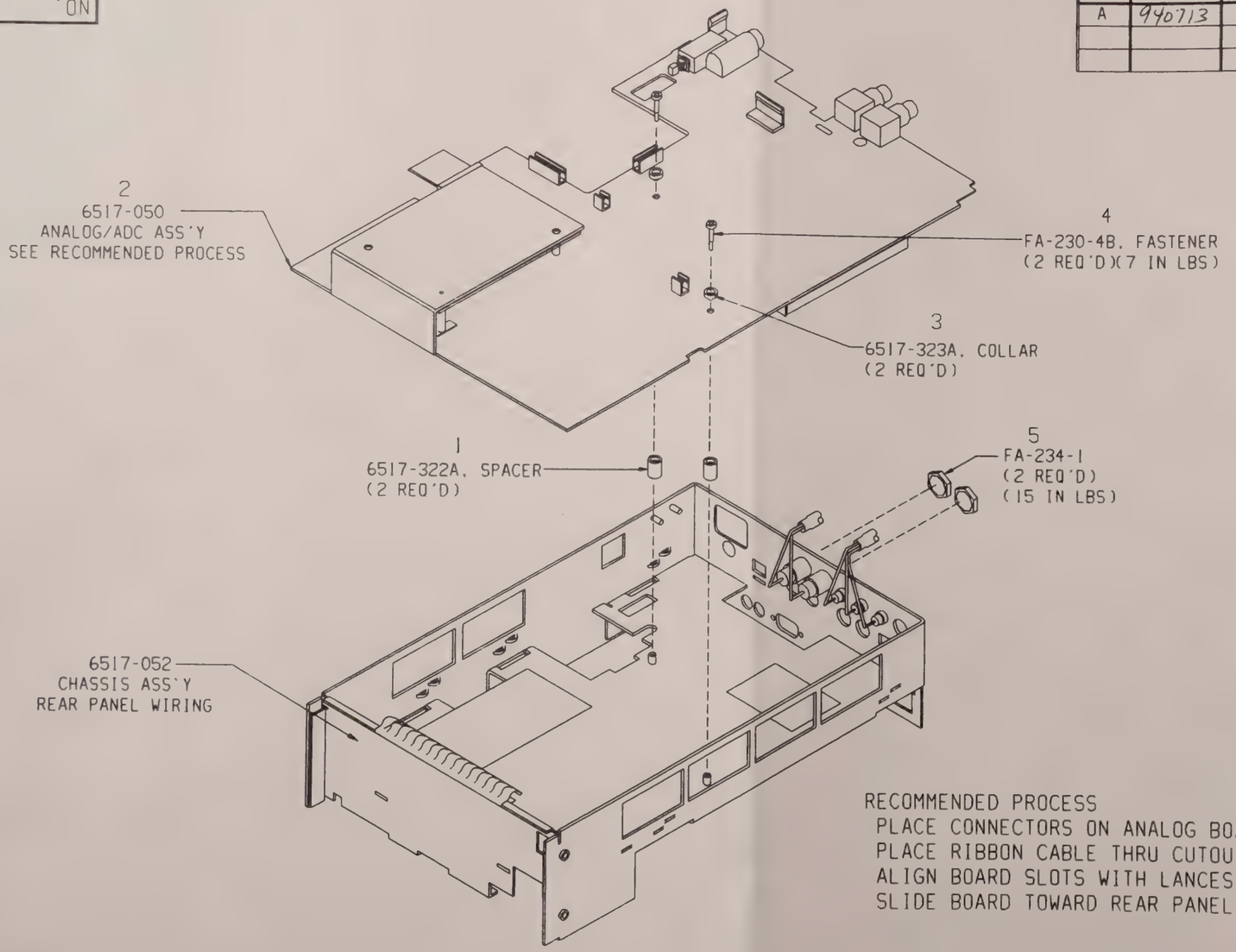
DATE 5/16/94 SCALE X
DRN Mat ENG APPR LS
MATERIAL X
FINISH X

TITLE
REAR PANEL ASSEMBLY
AND WIRING

B NO. 6517-052

NO. 6517-053

LTR	ECA NO.		REVISION	ENG	DATE
A	940713	Released		SF	7/13/94



RECOMMENDED PROCESS
PLACE CONNECTORS ON ANALOG BOARD SLIGHTLY INTO HOLES IN CHASSIS.
PLACE RIBBON CABLE THRU CUTOUT IN CHASSIS.
ALIGN BOARD SLOTS WITH LANCES ON CHASSIS.
SLIDE BOARD TOWARD REAR PANEL.

PART NO.	QTY	DESCRIPTION
6517-052	1	CHASSIS/REAR PANEL WIRING
6517-322A	2	SPACER
6517-323A	2	COLLAR
6517-050	1	ANALOG/ADC ASS'Y
FA-234-1	2	1/2-28 SMALL NUT
FA-230-4B	2	FASTENER

6517	6517-054	Chassis Assembly	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
USED ON			

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX ± .015 ANG ± 1°
XXX ± .005 FRAC ± 1/64
SURFACE MAX 63

DATE 5/9/94 SCALE X
DRN Mat ENG APPR
MATERIAL X
FINISH X

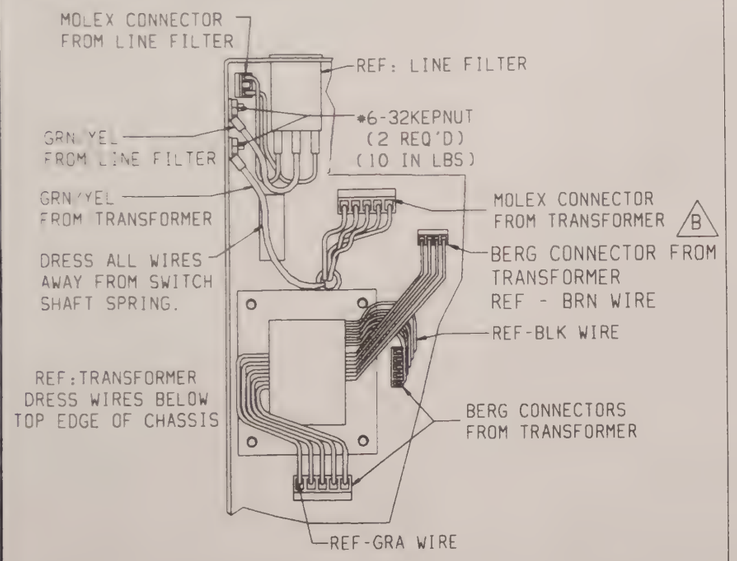
TITLE CHASSIS ASSEMBLY - OP8 (ANALOG SIDE)

B NO. 6517-053

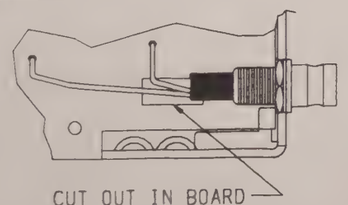
NO. 6517-054

LTR	ECA NO.	REVISION	ENG	DATE
A	940713	Released	ST	7/13/94
A1	16665	Line Connector Wires Location	ST	8/3/94
B	16850	Detail A Ipdated / Added Callouts	ST	[illegible]

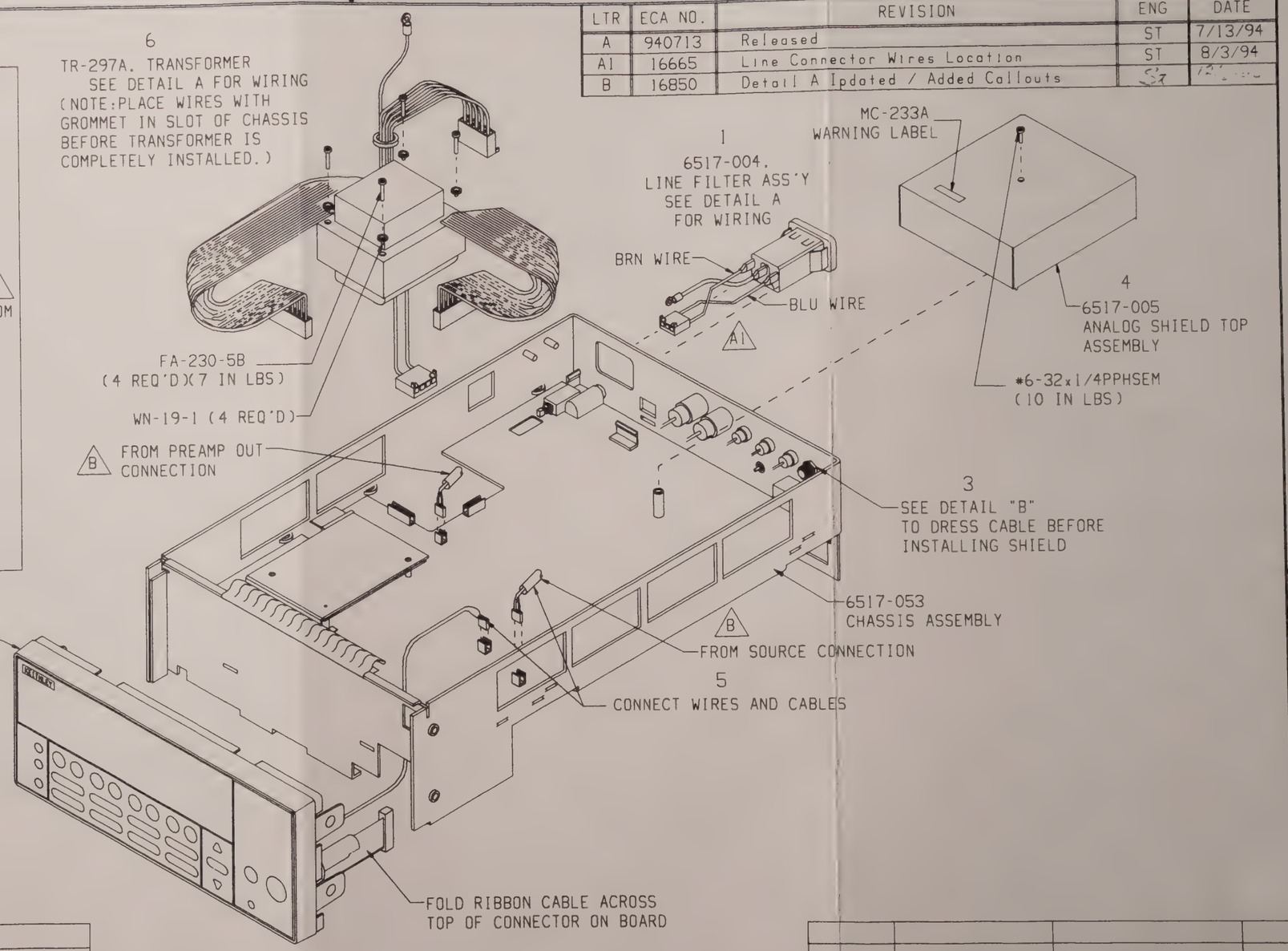
DETAIL A - LINE FILTER AND TRANSFORMER WIRING


MOLEX CONNECTOR FROM LINE FILTER
REF: LINE FILTER
*6-32KEPNUT (2 REQ'D) (10 IN LBS)
GRN/YEL FROM LINE FILTER
GRN/YEL FROM TRANSFORMER
MOLEX CONNECTOR FROM TRANSFORMER
B
DRESS ALL WIRES AWAY FROM SWITCH SHAFT SPRING.
BERG CONNECTOR FROM TRANSFORMER REF - BRN WIRE
REF-BLK WIRE
REF:TRANSFORMER DRESS WIRES BELOW TOP EDGE OF CHASSIS
BERG CONNECTORS FROM TRANSFORMER
REF-GRA WIRE

DETAIL B



DRESS CABLE DOWN AND LAY IN CUT OUT ON BOARD. THEN DRESS UPWARD TO INSTALL ENDS OF CABLE



PART NO.	QTY	DESCRIPTION
6517-053	1	CHASSIS ASS'Y
6517-040	1	FRONT PANEL ASS'Y
6517-004	1	WIRE CRIMP (LINE FILTER ASS'Y)
6517-005	1	ANALOG SHIELD, TOP ASSEMBLY
TR-297A	1	TRANSFORMER
*6-32KEPNUT	2	KEPNUT
#6-32x1/4"PPHSEM	1	PHIL PAN HD SEMS SCREW
MC-233A	1	WARNING LABEL
WN-19-1	4	WASHER, NYLON
FA-230-5B	4	FASTENER

6517	6517-055	Chassis Assembly	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
USED ON			

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XX = ±.015 ANG = ±1°
XXX = ±.005 FRAC = ±1/64
SURFACE MAX 63

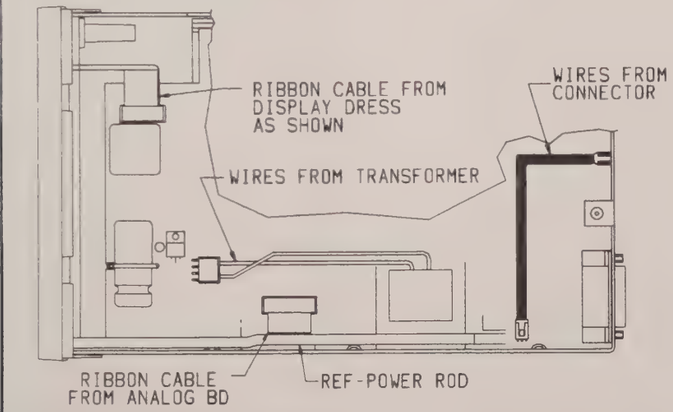
DATE 5/18/94 SCALE X
DRN Mat ENG APPR
MATERIAL X
FINISH X

TITLE CHASSIS ASSEMBLY - OP8

B NO. 6517-054

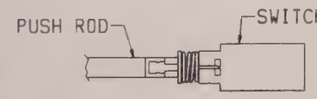
NO. 6517-055

DETAIL A - DIGITAL BOARD WIRING


RIBBON CABLE FROM DISPLAY DRESS AS SHOWN
WIRES FROM CONNECTOR
WIRES FROM TRANSFORMER
RIBBON CABLE FROM ANALOG BD
REF-POWER ROD

DETAIL B PROPERLY INSTALLED PUSH ROD

TOP VIEW



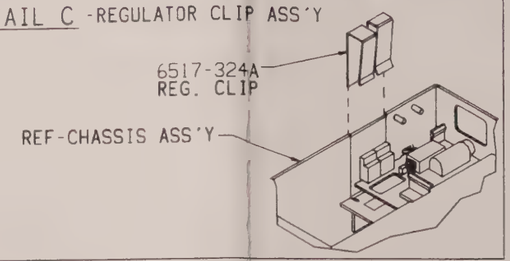
PUSH TOP OF SWITCH SHAFT DOWN INTO PUSHROD UNTIL IT BOTTOMS OUT.

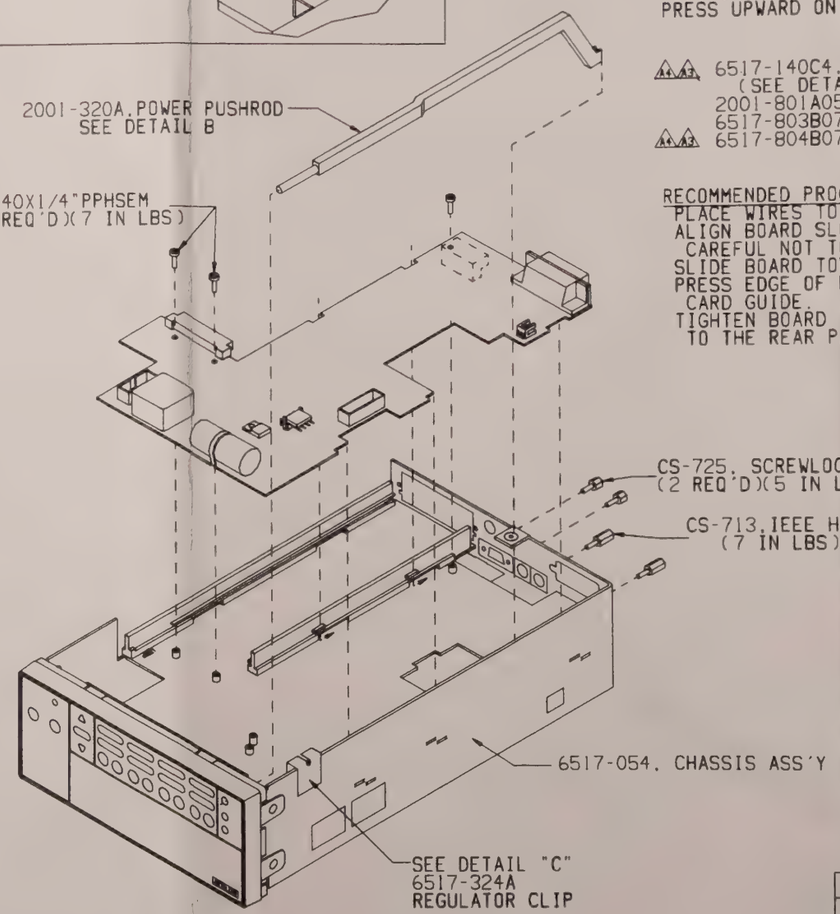
SIDE VIEW

PRESS UPWARD ON PUSHROD WHILE PUSHING SWITCH SHAFT DOWN

RECOMMENDED PROCESS FOR ANALOG RIBBON CABLE
PULL RIBBON CABLE STRAIGHT UP (EXCESS LENGTH ON THIS SIDE).
PLUG CABLE INTO CONNECTOR THEN FOLD SLIGHTLY TOWARDS CONNECTOR.
PUSH EXCESS DOWN INTO CHASSIS. BUT DO NOT BLOCK VENT HOLES ON THE SIDE.
MAKE SURE PUSHROD IS NOT RUBBING ON CABLE.

DETAIL C -REGULATOR CLIP ASS'Y




2001-320A, POWER PUSHROD SEE DETAIL B
#4-40X1/4"PPHSEM (3 REQ'D)(7 IN LBS)
CS-725, SCREWLOCK, FEMALE (2 REQ'D)(5 IN LBS)
CS-713, IEEE HARDWARE KIT (7 IN LBS)
6517-054, CHASSIS ASS'Y
SEE DETAIL "C" 6517-324A REGULATOR CLIP

LTR	ECA NO.	REVISION	ENG	DATE
A3	17062	6517-140C3 WAS 6517-140C2. 6517-803B06 WAS 6517-803B05 AND 6517-804B06 WAS 6517-804B05.		
A4	17127	6517-140C4 WAS 6517-140C3. 6517-803B07 WAS 6517-803B06 AND 6517-804B07 WAS 6517-804B06.		

RECOMMENDED PROCESS
PLACE POWER ROD THRU FRONT PANEL(PUSH DOWN SLIGHTLY ON ROD TO GO UNDER EDGE OF FRONT PANEL).
PUT OTHER END OF ROD THRU CUTOUT IN CHASSIS TO SWITCH ON ANALOG BOARD.
PRESS UPWARD ON ROD TO INSTALL ON SWITCH(SEE DETAIL).

A3 A4 6517-140C4, DIGITAL BOARD ASS'Y
(SEE DETAIL A FOR WIRING)
2001-801A05 EPROM (REF)
6517-803B07 EPROM (REF)
A3 A4 6517-804B07 EPROM (REF)

RECOMMENDED PROCESS
PLACE WIRES TO EDGE OF CHASSIS.
ALIGN BOARD SLOTS WITH LANCES ON CHASSIS, BEING CAREFUL NOT TO PINCH WIRES, OR RIBBON CABLE.
SLIDE BOARD TOWARDS REAR PANEL, AGAIN CHECKING WIRES.
PRESS EDGE OF BOARD DOWN TO SNAP INTO PLACE ON LONG CARD GUIDE.
TIGHTEN BOARD TO CHASSIS BEFORE TIGHTENING THE CONNECTORS TO THE REAR PANEL.

PART NO.	QTY	DESCRIPTION
6517-054	1	CHASSIS ASS'Y
6517-140C4	1	DIGITAL BD ASS'Y (REF 2001-801A05) A3 A4
		(REF 6517-803B07) A3 A4
		(REF 6517-804B07) A3 A4
2001-320A	1	POWER PUSHROD
6517-324A	1	REGULATOR CLIP
CS-713	1	IEEE HARDWARE KIT
CS-725	2	SCREWLOCK, FEMALE
#4-40X1/4"PPHSEM	3	PHIL PAN HD SEMS SCREW

6517	6517-057	CHASSIS ASS'Y	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
USED ON			

DO NOT SCALE THIS DRAWING

KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ±.015 ANG = ±1°
XXX = ±.005 FRAC = ±1/64
SURFACE MAX 63

DATE 5/23/94 SCALE X
DRN MAT ENG APPR LS
MATERIAL X
FINISH X

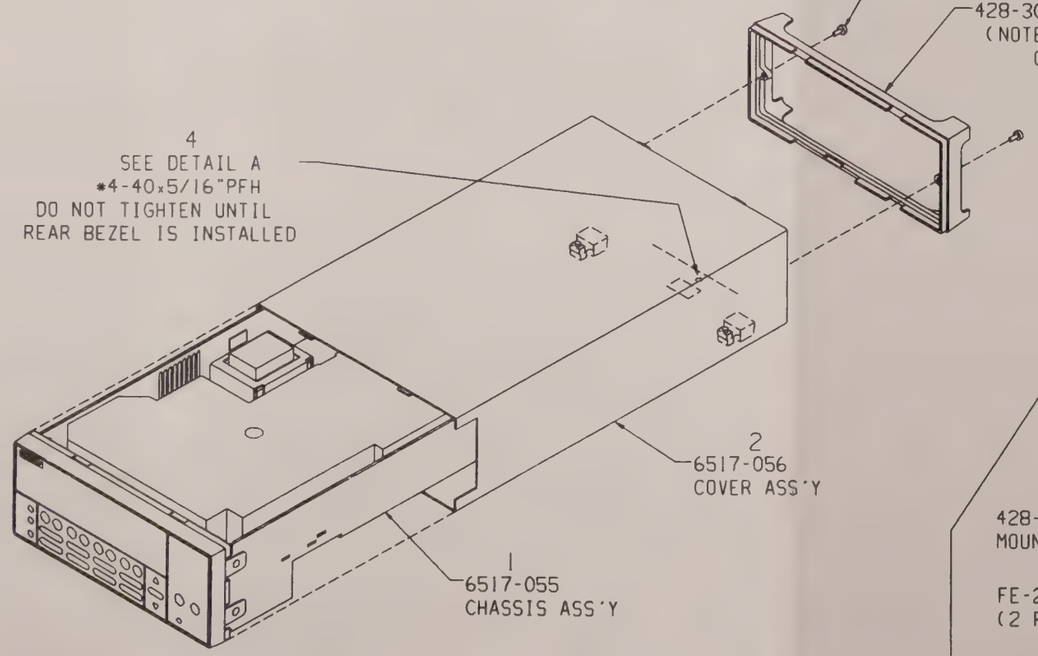
TITLE CHASSIS ASSEMBLY - OP8

B NO. 6517-055

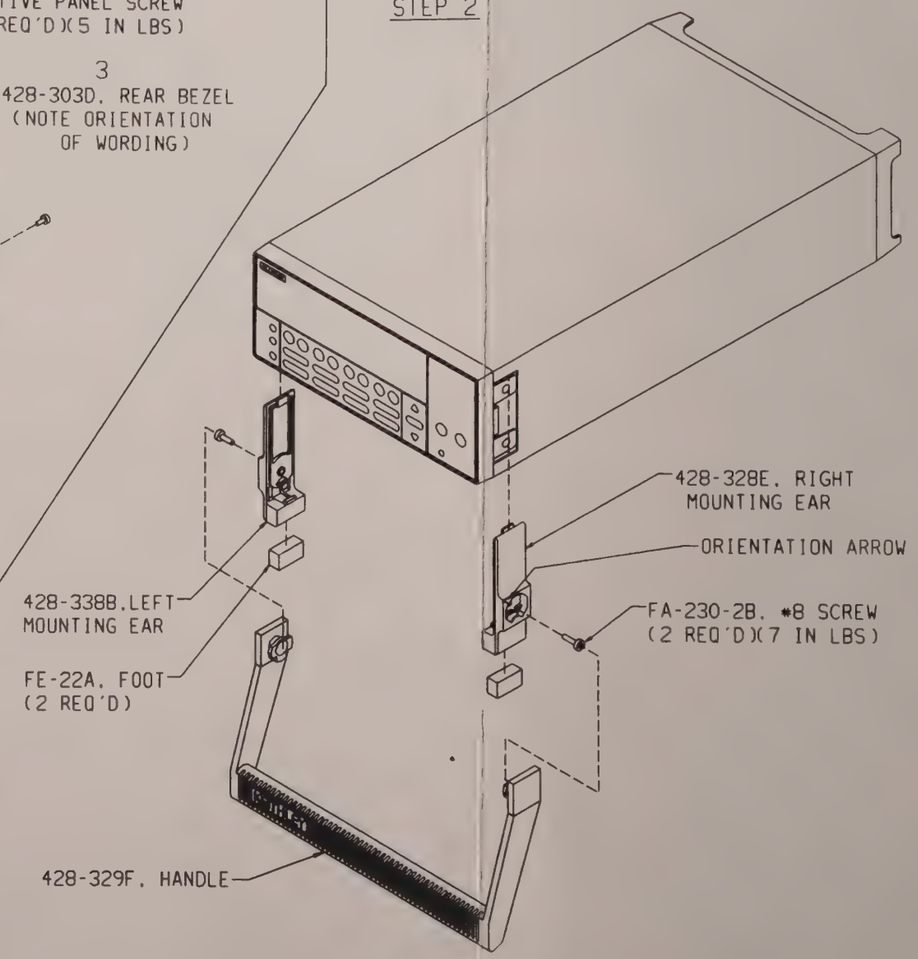
NO. 6517-057

LTR	ECA NO.	REVISION	ENG	DATE
A	940713	Released	S.T.	7/13/94

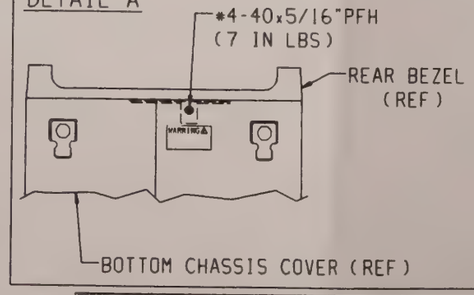
STEP 1



STEP 2



DETAIL A



PART NO.	QTY	DESCRIPTION
6517-055	1	CHASSIS ASS'Y
6517-056	1	COVER ASS'Y
428-303D	1	REAR BEZEL
428-328E	1	MOUNTING EAR RIGHT
428-329F	1	HANDLE
428-338B	1	MOUNTING EAR LEFT
FA-230-2B	2	FASTENER
FA-232-1C	2	CAPTIVE PANEL SCREW
FE-22A	2	FOOT
*4-40x5/16"PFH	1	PHIL FLAT HD SCREW

6517	6517-058	FINAL CHASSIS ASS'Y	1
MODEL	NEXT ASSEMBLY	NEXT PROCESS STEP	QTY
USED ON			

DO NOT SCALE THIS DRAWING

KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

XX = ±.015 ANG = ±1°

XXX = ±.005 FRAC = ±1/64

SURFACE MAX 63

DATE 5/23/94 SCALE X

DRN Mat ENG APPR

MATERIAL X

FINISH X

TITLE: CHASSIS ASS'Y - OP8

B NO. 6517-057

4

Replaceable Parts

4.1 Introduction

This section contains replacement parts information and component layout drawings for the Model 6517.

4.2 Parts lists

The electrical parts lists for the Model 6517 are shown in Tables 4-1 to 4-4. For part numbers to the various mechanical parts and assemblies, use the Miscellaneous parts list and the assembly drawings provided at the end of Section 3.

4.3 Ordering information

To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the factory (see inside front cover for addresses). When ordering parts, be sure to include the following information:

- Instrument model number (Model 6517)
- Instrument serial number
- Part description
- Component designation (if applicable)
- Keithley part number

To facilitate repairs, complete circuit boards are available. Contact the Repair Department (see below) for pricing and availability.

4.4 Factory service

If the instrument is to be returned to Keithley Instruments for repair, perform the following:

1. Call the Repair Department at 1-800-552-1115 for a Return Material Authorization (RMA) number.
2. Complete the service form at the back of this manual, and include it with the instrument.
3. Carefully pack the instrument in the original packing carton.
4. Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.

4.5 Component layouts

The component layouts are provided in the following pages:

A/D Converter board: 2001-160
Display board: 2002-110
Analog board: 6517-100
Digital board: 6517-140

Table 4-1
Model 6517 ADC board, parts list

Circuit designation	Description	Keithley part number
	ADC ASSEMBLY	2001-160
	CHOKE 21-030-J	CH-55
	DIODE,ZENER 6.4V,IN4579 (DO-7)	DZ-73-1
	PROGRAM	2001-802*
	SOCKET, 68-PIN QUAD	SO-128-68
C800-803,807,809,815,819,820	CAP,.1UF, 20%,50V,CERAMIC(1206)	C-418-.1
C804,805	CAP,.1UF, 20%,50V,CERAMIC(1206)	C-418-.1
C808,818	CAP,1UF,20%,50V, CERAMIC	C-237-1
C812,826-829	CAP, 10UF,20%, 25V, TANTALUM (D7243)	C-440-10
C814,824	CAP, 10UF,20%, 25V, TANTALUM (D7243)	C-440-10
C817	CAP, 150PF, 5%, 100V,CERAMIC (0805)	C-465-150P
C821	CAP,.33UF,10%, 50V CERAMIC (1812)	C-464-.33
C822,823	CAP, 27PF, 10%, 100V, CERAMIC(1206)	C-451-27P
C825	CAP, .01UF, 10%,100V POLYPROPYLENE	C-306-.01
C831	CAP, 33PF, 10%, 100V, CERAMIC (1206)	C-451-33P
CR801	DIODE, DUAL SWITCHING, BAV99L(SOT-23)	RF-82
P1026	CONNECTOR, FEMALE 25 PIN	CS-767-25
Q800	TRANS, PNP, MMBT3906L(SOT-23)	TG-244
Q801	TRANS, NPN, MMBT3904 (SOT-23)	TG-238
Q802-806,814	TRANS,N CHAN MOSPOW FET,2N7000 (TO-92)	TG-195
Q807,809,811	TRANS, SELECTED TG-128 (T0-92)	31841A
Q808,813	TRANS,N CHANNEL JFET,SELECTED J210	TG-167-1
Q810	TRANS,N CHANNEL JFET,5432 (TO-92)	TG-198
Q812	IC, +5V REGULATOR, 78L05AC, (T0-92)	IC-603
R800,813,838	RES, 100K, 5%, 125mW, METAL FILM (1206)	R-375-100K
R801	RES, 475, 1%, 125mW, METAL FILM (1206)	R-391-475
R802-805	RES, 2.21K, 1%, 125mW, METAL FILM (1206)	R-391-2.21K
R806,827	RES, 33.2K, 1%, 125mW, METAL FILM (1206)	R-391-33.2K
R808,859,811,812,862	RES,10K,5%,125MW,METAL FILM(1206)	R-375-10K
R810,820	RES, 2.7K, 5%, 125mW, METAL FILM (1206)	R-375-2.7K
R814	RES, 5.1K,5%, 125MW, METAL FILM (1206)	R-375-5.1K
R815,829	RES, 82.5, 1%, 125mW, METAL FILM (1206)	R-391-82.5
R818,823	RES, 2.74K, 1%, 1/8W,METAL FILM	R-88-2.74K
R819	RES, 18.7, 1%, 125mW, METAL FILM (1206)	R-391-18.7
R821,822,864	RES,1K,5%,125MW,METAL FILM(1206)	R-375-1K
R824,830	RES, 4.75K, 1%, 125mW, METAL FILM (1206)	R-391-4.75K
R826	RES,3.92K, 1%, 125mW, METAL FILM (1206)	R-391-3.92K
R828,861	RES, 26.7K, 1%, 125mW,METAL FILM (1206)	R-391-26.7K
R833-836	RES,1K,.1%,1/10W,METAL FILM	R-263-1K
R837,846	RES, 19K, .1%, 1/10W, METAL FILM	R-263-19K
R839	RES, 100K, 5%, 125mW, METAL FILM (1206)	R-375-100K

*Order revision level.

Table 4-1 (cont.)
Model 6517 ADC board, parts list

Circuit designation	Description	Keithley part number
R840	RES, 40K, .1%, 1/10W, METAL FILM	R-263-40K
R841	RES, 57.8K, .1%, 1/10W METAL FILM	R-263-57.8K
R842	RES, 920K, .1%, 1/10W METAL FILM	R-168-920K
R843	RES, 1.2K, .1%, 1/10W, METAL FILM	R-263-1.2K
R844	RES, 4.M, .1% 1/8W METAL FILM	R-402-4M
R845	RES,2K,.1%,1/10W,METAL FILM	R-263-2K
R847	RES, 3.2K,.1%, 1/10W, METAL FILM	R-263-3.2K
R848,851-853	RES, 49.9, 1%, 125mW, METAL FILM (1206)	R-391-49.9
R849,855,858,865	RES, 3.01K, 1%, 125MW, METAL FILM(1206)	R-391-3.01K
R850	RES,100,1%,1/8W,METAL FILM	R-88-100
R854	RES,1.62K,1%,1/8W,METAL FILM	R-88-1.62K
R856,857	RES,10,5%,125MW,METAL FILM(1206)	R-375-10
R860	RES, 150K, 5%, 125MW, METAL FILM (1206)	R-375-150K
R863	RES, 100, 1%, 125mW, METAL FILM (1206)	R-391-100
U800,801	IC, 8 STAGE SHIFT/STORE,MC14094BD(SOIC)	IC-772
U802	IC, OP-AMP, NE5534D (SOIC)	IC-802
U803,804	IC, VOLT. COMPARATOR,LM311M (SOIC)	IC-776
U806	IC, VOLT COMPARATOR LM393D(SOIC)	IC-775
U807	IC, QUAD COMPARATOR,LM339D (SOIC)	IC-774
U809	IC,OP-AMP,OPA602AP	IC-703
U810,811	IC, OP-AMP,LT1097	IC-803
U812	IC, DUAL D-TYPE F/F, 74HC74(SOIC)	IC-773
U813	INTEGRATED CIRCUIT, OPA177GS(SOIC)	IC-960
Y800	OSCILLATOR CMOS, 7.68 MHZ	CR-31

Table 4-2
Model 6517 display board, parts list

Circuit designation	Description	Keithley part number
	BUMPER	FE-27A
	CLIP, GROUND	2001-352B
	DISPLAY BOARD ASSEMBLY	2002-110
	TAPE, 3/4 WIDE X 1/32 THICK	TP-12-1
C901	CAP, 22UF, 20%, 6.3, TANTALUM (C6032)	C-417-22
C902,904,907,908,910	CAP, .1UF, 20%, 100V, CERAMIC (1812)	C-436-.1
C903,905,906,909,911	CAP, .1UF, 20%, 50V, CERAMIC (1206)	C-418-.1
C912	CAP, 2.2UF, 20%, 100V, ALUM ELEC	C-503-2.2
C913,914	CAP, 100UF, 20%, 16V, TANTALUM (7243)	C-504-100
C915,916	CAP, 33PF, 10%, 100V, CERAMIC (1206)	C-451-33P
CR901-904	DIODE, SWITCHING, 250MA, BAV103 (SOD-80)	RF-89
CR905,906	DIODE, SWITCHING, MMBB914 (SOT-23)	RF-83
DS901	VACUUM FLUORESCENT DISPLAY	DD-51C
P1033	CABLE ASSEMBLY	CA-62-4A
Q901,902	TRANS, NPN GEN PURPOSE BC868	TG-293
R901	RES NET, 15K, 2%, 1.875W (SONIC)	TF-219-15K
R902	RES, 13K, 5%, 125MW, METAL FILM (1206)	R-375-13K
R903,904	RES, 4.7K, 5%, 250MW, METAL FILM (1210)	R-376-4.7K
R905	RES, 1M, 5%, 125MW, METAL FILM (1206)	R-375-1M
R906	RES, 1K, 5%, 250MW, METAL FILM (1210)	R-376-1K
R907	RES, 240, 5%, 250MW, METAL FILM (1210)	R-376-240
R908	RES, 10M, 5%, 125MW, METAL FILM (1206)	R-375-10M
T901	TRANSFORMER, TDK, ER14.5 SERIES	TR-300
U901,904,905	IC, LATCHED DRIVERS, UCM-5812EPF-1 (PLCC)	IC-732
U902	PROGRAM	7001-800*
U903	IC, 32-BIT, SERIAL UCN5818EPF-1 (PLCC)	IC-830
VR901	DIODE, ZENER 8.2V, MMBZ5237 (SOT-23)	DZ-92
Y901	CRYSTAL, 4MHZ (SMT)	CR-36-4M

*Order revision level.

Table 4-3
Model 6517 analog board, parts list

Circuit designation	Description	Keithley part number
	ANALOG ASSEMBLY	6517-100
	FUSE HOLDER	FH-32
	HEAT SINK	6517-329A
	HEAT SINK	HS-33
	LATCHING HEADER, FRICTION, SINGLE ROW	CS-724-10
	LATCHING HEADER, FRICTION, SINGLE ROW	CS-724-12
C201-203,309,310	CAP, 470UF, 20%, 25V ALUM ELEC	C-413-470
C204-208,210,212,214,215,263, 264,321,405, 409-413,417,418, 423-428,458,459,440,441	CAP, .1UF, 10%, 25V, CERAMIC (0805)	C-495-.1
C209,211,216,407,422	CAP,100UF,20%,25V,ALUM ELEC	C-413-100
C217,218,305	CAP, 1000UF, +/-20%, 25V ALUM ELECT	C-413-1000
C219	CAP, 47PF, 5%, 500V, POLYSTYRENE	C-138-47P
C250,251	CAP,.33,.20%,50V POLYESTER DIELECTRIC	C-344-.33
C260,261,322,323,338,364-366	CAP, .01UF, 10%, 50V CERAMIC(0805)	C-491-.01
C262,452	CAP, 10UF,20%, 25V, TANTALUM (D7243)	C-440-10
C301,302	CAP, 100UF, +/-20%,,200V ALUM ELECT	C-498-100
C303,304	CAP, 2.2UF, +/-20%, 200V ALUM ELECT	C-498-2.2
C306-308,324,331,332	CAP, 10UF,-20+100%,25V,ALUM ELEC	C-314-10
C311-313,315-317	CAP, 100UF, +/-20%, 450V, ALUM ELECTR	C-499-100
C314,318,330	CAP, .01, 20%, 2000V, CERAMIC	C-324-.01
C319,320,429	CAP, 10PF, 5%, 50V, MONO CERAMIC(0805)	C-452-10P
C333	CAP,100PF,10%,1000V,CERAMIC	C-64-100P
C334	CAP,33PF,10%,1000V,CERAMIC	C-64-33P
C335	CAP,15PF,10%,1000V,CERAMIC	C-64-15P
C336	CAP,1UF,20%,50V, CERAMIC	C-237-1
C337,340-344	CAP,470PF,10%, 1000V CERAMIC	C-64-470P
C339	CAP,47PF,10%,1000V,CERAMIC	C-64-47P
C401,403	CAP, 47UF, +/- 20%, 350V ALUM ELEC	C-501-47
C402,404,460,461	CAP,220UF, +/-20%, 50V ALUM ELEC	C-507-220
C406	CAP,.5PF, 2.5%,630V,POLYPROPYLEN	C-405-5P
C408	CAP,2200UF,-20+100%,25V,ALUM ELEC	C-314-2200
C414	CAP, .001UF, 10%, 100V, POLYESTER	C-511-.001
C416	CAP,560PF,2.5%,630V,POLYPROPYLENE	C-405-560P
C420	CAP,100PF,2.5%,630V,POLYPROPYLENE	C-405-100P
C421	CAP, 10000PF, 5%, 500V, POLYSTYRENE	C-138-10000P
C457	CAP,.0033,20%,500V, CERAMIC	C-22-.0033
C501,502	CAP, 150PF, 5%, 100V,CERAMIC (0805)	C-465-150P
C550,551	CAP, .01UF, 10%, 200V CERAMIC (1206)	C-472-.01
CR201,301	DIODE,SILICON,W04M (CASE WM)	RF-46
CR202,306,307,402,403	DIODE,BRIDGE,VM18	RF-52
CR302,303,308	DIODE, HI-VOLTAGE, HV-15	RF-76
CR304,305	DIODE HI-VOLTAGE	RF-101
CR401	DIODE	RF-104
CR404,408,412,413	DIODE,SILICON,IN4006 (D0-41)	RF-38
CR406,407	DIODE,SILICON,IN4148 (DO-35)	RF-28

Table 4-3 (cont.)
Model 6517 analog board, parts list

Circuit designation	Description	Keithley part number
F101	FUSE, .5A, 250V	FU-71
F201	FUSE	FU-100-1
J1002	CONN, MOLEX, 3-PIN	CS-772-3
J1010	CONNECTOR TEMPERATURE	CS-823
J1011	CONN, 6 PIN CIRCULAR DIN	CS-811
J1012,J1013	CONN, BNC	CS-547
J1019,1020	CONN, CONTACT PIN	TE-110
J1021-1023,1028	LATCHING HEADER,FRICTON, SGL ROW	CS-724-3
J1024	CONNECTOR, HEADER	CS-784-6
J1025	MODIFIED BERG HEADER	6517-326-1A
J1026	HEADER, DUAL BODY/STRAIGHT PIN	CS-765-25
J1027	MODIFIED BERG HEADER	6517-326-2A
K301,305,306	RELAY, REED HI VOLT 1FORMA 7301-05-1010	RL-173
K302-304,413,414	RELAY, HIGH VOLT/SOLID STATE LH1056AT	RL-139
K401,402,411,412	RELAY, 1FORMC	RL-175
K405,406,416	RELAY, 1FORMA, COTO 1203-0147	RL-181
K417-419	RELAY, MINI SIGNAL REL	RL-163
P1029	CABLE ASSEMBLY	CA-27-18D
Q301,302,306,307,316,402,409	TRANS,NPN SILICON,2N3904 (TO-92)	TG-47
Q303,304,308,309,403,404	TRANS,PNP SILICON 2N3906 (TO-92)	TG-84
Q305	IC, +5V REGULATOR, 78L05AC, (T0-92)	IC-603
Q311,313,315,317	TRANS, C-CHAN MOSFET, 2SK1412(TO-220ML)	TG-276
Q314	TRANS,N CHAN MOSPOW FET,2N7000 (TO-92)	TG-195
Q401	IC, -5V REGULATOR, 7905AC(TO-92)	IC-604
Q405,408,410	TRANS, N-CHAN,DMOSFRET,VN0550N3(TO-92)	TG-283
Q406,407,411	TRANS, P-CHAN,DMOSFET VP055ON3(TO-92)	TG-284
Q412	TRANS,PNP POWER,MJE350	TG-210
Q413	TRANS,NPN SILICON,MJE340	TG-209
Q414,420	TRANS, DUAL NPN IT121 (TO-52)	TG-91
R201-203,205,206,325-328,351, 395,446,447,517,520,521,532	RES, 1K, 1%, 100MW, THICK FILM (0805)	R-418-1K
R204,511,512,514-516,518,519	RES, 274, 1%, 100MW, THICK FILM(0805)	R-418-274
R207,218,241,509	RES, 121K, 1%,100MW, THICK FILM(0805)	R-418-121K
R208,209	RES, 140K, 1%, 100MW THICK FILM (0805)	R-418-140K
R210,211,427	RES, 357K, 1%, 100MW, THICK FILM(0805)	R-418-357K
R212,213,311,401,420,421,491	RES, 49.9K, 1%, 100MW THICK FILM(0805)	R-418-49.9K
R214,419,435	RES, 24.9K, 1%, 100MW, THICK FILM (0805)	R-418-24.9K
R215,228-231,340-345,402,405	RES, 4.99K, 1%, 100MW THICK FILM(0805)	R-418-4.99K
R216	RES, 10K, 5%, 250MW, METAL FILM(1210)	R-376-10K
R219,221,223,437	RES,1M,0.1%,1/4W,METAL FILM	R-374-1M
R220	RES, 5M, 5%, .25W THICK FILM	R-432-5M
R222	RES, 50K,.1%, 1/10W, METAL FILM	R-263-50K
R224	RES, 500K, .1%, 1/10W, METAL FILM	R-263-500K
R266,225,227	RES, 1.5K, 1%, 100MW THICK FILM (0805)	R-418-1.5K

Table 4-3 (cont.)
Model 6517 analog board, parts list

Circuit designation	Description	Keithley part number
R301,302,424,425,510,513	RES, 200K, 5%, 250MW, METAL FILM (1210)	R-376-200K
R303,306,310,321	RES, 2.21K, 1%, 100MW, THICK FILM (0805)	R-418-2.21K
R304,308,314,316,441,463	RES,4.02K,1%,100MW, THICK FILM(0805)	R-418-4.02K
R305,307,312,318,494,495	RES, 100, 1%, 100MW, THICK FILM (0805)	R-418-100
R309,334,475-477	RES, 100K, 1%, 100MW THICK FILM(0805)	R-418-100K
R313,335	RES, 75K, 1%, 100MW THICK FILM (0805)	R-418-75K
R315,317,319,320,322,329,332	RES, 10M, 10%, 525MW, THICK FILM(1505)	R-430-10M
R323,415,508,492,493,433,458	RES, 499, 1%, 100MW THICK FILM(0805)	R-418-499
R324	RES, 249,1%, 100MW, THICK FILM(0805)	R-418-249
R336-339	RES, 2M, 1%, 100MW, THICK FILM(0805)	R-418-2M
R346	RES, 806, 1%, 100MW THICK FILM (0805)	R-418-806
R347,459-462,502,240,217	RES, 1M, 1%, 100MW, THICK FILM(0805)	R-418-1M
R354	RES, 10M, 2%, 1W, 1500VDC, THICK FILM	R-417-10M
R358-360,397,398,414,448	RES, 10M, 10%, 525MW, THICK FILM(1505)	R-430-10M
R361	RES, 48.1K, .1%, 1/10W METAL FILM	R-263-48.1K
R362	RES, 487K, .1%, 1/10W METAL FILM	R-263-487K
R364,370,598	RES, 7.32, 1%, 100MW THICK FILM (0805)	R-418-7.32
R367	RES, 59K, 1%, 100MW THICK FILM(0805)	R-418-59K
R368	RES, 82.5, 1%, 100MW, THICK FILM (0805)	R-418-82.5
R369	RES, 66.5, 1%,, 100MW THICK FILM (0805)	R-418-66.5
R371	THICK FILM	TF-248
R373-389,449-453, 464-470, 527	RES, 470K, 5%, 250MW, METAL FILM(1210)	R-376-470K
R390-392,403,404,406,407,412	RES, 10K, 1%, 100MW, THICK FILM (0805)	R-418-10K
R396,523,504,416	RES, 2K, 1%, 100MW, THICK FILM(0805)	R-418-2K
R411	RES, 4T, 10%, 1W, 1500VDC THICK FILM	R-429-4T
R413,525	RES, 249K, 1%, 100MW, THICK FILM(0805)	R-418-249K
R426,480,481	RES, 10, 10%, 100MW, THICK FILM(0805)	R-418-10
R428,429	RES, 24.3, 1%, 100MW, THICK FILM(0805)	R-418-24.3
R430,440	RES, 402K, 1%, 100MW THICK FILM(0805)	R-418-402K
R431	RES, 1G, 10%, HIGH ALUMINA	R-435-1G
R432	RES, 1T, 10%, 1W, 1500VDC, THICK FILM	R-429-1T
R434,417	RES, 10K, 1%, 100MW, THICK FILM (0805)	R-418-10K
R436	RES, 255K, 1%, 100MW, THICK FILM(0805)	R-418-255K
R438,439,443	RES, 3K,1%, 750MW, FILM	R-436-3K
R442	RES, 150K, 5%,250MW,METAL FILM(1210)	R-376-150K
R490	RES, 30.1K, 1%, 100MW, THICK FILM (0805)	R-418-30.1K
R496,497	RES, 49.9, 1%, 100MW THICK FILM(0805)	R-418-49.9
R501,506	RES, 392, 1%, 100MW, THICK FILM (0805)	R-418-392
R505	RES, 80.6K, 1%, 100MW, THIN FILM(0805)	R-438-80.6K
R507	RES, 24.9K, 1%, 100MW, THIN FILM(0805)	R-438-24.9K
R522	RES, 3.01K, 1%, 100MW THICK FILM(0805)	R-418-3.01K
R524	RES, 80.6K, 1%, 100MW THICK FILM (0805)	R-418-80.6K
R526	RES,1K, 5% 250MW, METAL FILM (1210)	R-376-1K
R530,531	RES, 1M, 5%, 250MW METAL FILM (1210)	R-376-1M
R595	RES, 33.2, 1%, 100MW, THICK FILM(0805)	R-418-33.2

Table 4-3 (cont.)
Model 6517 analog board, parts list

Circuit designation	Description	Keithley part number
S101	SWITCH,PUSHBUTTON (6 POLE)	SW-466
S102	SWITCH, SLIDE (DPDT)	SW-397
S103	SWITCH,SLIDE (DPDT)	SW-476
U201,304,410	IC, 8-BIT SERIAL-IN LATCH DRIVER,5841A	IC-536
U202,305,306,403,404	IC,8 STAGE SHIFT/STORE REGISTER,4094	IC-251
U204,311	IC, DUAL, VOLTAGE COMPARATOR, LM393	IC-343
U205	IC,NEG VOLTAGE REG -15V,500MA,79M15	IC-195
U206	IC,POS VOLTAGE REG +15V,500MA,7815	IC-194
U208	IC, 7V PRECISION REFERENCE, LT1021-7	IC-928
U209	IC, OP-AMP,LT1097	IC-803
U210,211	IC, CMOS, ANALOG SWITCH MAX326 16PIN DIP	IC-971
U212,312,409	IC,SPST CMOS ANALOG SWITCH, (DG411)	IC-667
U214	IC,22V OP-AMP, LT1007ACN8	IC-422
U215	IC,8-BIT CMOS MICROCTRL, P1C16C54-HS/P	IC-977
U220	IC,DUAL D-TYPE FLIP FLOP,74HC74	IC-337
U301	IC, POS +12V VOLTAGE REG, 78L12	IC-522
U302	IC, NEG -12V VOLTAGE REG, LM79L12	IC-523
U303	PROGRAM	6517-801*
U307	IC, BIFET OP-AMP AD548KN	IC-970
U308	IC 16 BIT VOLTAGE OUTPUT DAC, AD7846	IC-734
U309	IC,5V REFERENCE,AD586L	IC-681
U310	IC, MOSFET DRIVER, TLP590A	IC-812
U313-318	IC, ADJ CURRENT SOURCE, LM234Z-6(TO-92)	IC-961
U320	IC,UNDERVOLT SENSOR, MC34064	IC-716
U401,402,213,502	IC,DUAL JFET OP-AMP,LT1013	IC-423
U405	IC, 25FA, ELECTRO-AMP	IC-943
U406	IC, POWER VOLT REF, LT1004CZ 2.5(TO-92)	IC-929
U407	IC, DUAL 12-BIT CMOS D/A CONV, DAC-8221	IC-927
U408,U207	IC,+5V VOLTAGE REGULATOR,LM2940CT	IC-576
U411-413	IC, LOW INPUT CURRENT OPTO, HCPL-2200	IC-411
U414	IC, CENTIGRADE TEMP SENSOR,LM35DZ(TO-92)	IC-933
U516	IC, OTC BFR/LINE DRIVER/REC,74HCT244	IC-934
U501,503	IC, LINEAR OPTOCOUPLER, IL-300DEFG	IC-972
U504	IC, DUAL PICOAMP INPUT OP-AMP,AD706	IC-483
U505,506,508-513	IC,OPTOCOUPLER,TLP582	IC-689
VR301-304	DIODE,ZENER 24V,IN723 (D0-7)	DZ-17
VR306,307,309,310-312,401, 402	DIODE, ZENER 9.1V, IN4739A (DO-35)	DZ-56
VR403,404	DIODE, ZENER 5.1V,IN751(DO-7)	DZ-59
VR506,507,501,308,309	DIODE,ZENER 6.4V,IN4571 (D0-7)	DZ-60
Y301	CRYSTAL,8.0000MHZ	CR-24-1

*Order revision level.

Table 4-4
Model 6517 digital board, parts list

Circuit designation	Description	Keithley part number
	BATTERY HOLDER FOR BT1	BH-34
	DIGITAL ASSEMBLY	6517-140
	SOCKET, 32 PIN FOR U637 AND U638	SO-103-32
CR603,605,607,609-618, 635-642	DIODE, SWITCHING, 250MA,BAV103 (SOD-80)	RF-89
CR622	DIODE, BRIDGE PE05 (CASE KBU)	RF-48
CR627,628	DIODE,ARRAY,MMAD1103,(SOIC)	RF-80
J1014	CONN, RT ANGLE, MALE, 9 PIN	CS-761-9
J1015,1016	CONN, CIRCULAR DIN	CS-762
J1018	CONN,RIGHT ANGLE,24PIN	CS-507
J1029	CONN, HEADER STRAIGHT SOLDER PIN	CS-368-26
J1030	CONNECTOR, MALE 4 PIN	CS-612-4
J1032	CONN, RT. ANGLE, MALE MOLEX .156	CS-715-4
J1033	CONN, HEADER STRAIGHT SOLDER PIN	CS-368-16
J1034	CONN, 48-PIN, 3-ROWS	CS-775-2
Q602-607	TRANS,N CHAN MOSPOW FET,2N7000 (TO-92)	TG-195
R601,603-605,672	RES, 2K, 1%, 125mW, METAL FILM (1206)	R-391-2K
R616,621,625,629,631	RES,10,5%,125MW,METAL FILM(1206)	R-375-10
R639	RES, 680K, 5%,125mW, METAL FILM (1206)	R-375-680K
R644	RES NET,4.7K,2%,1.875W(SOMIC)	TF-219-4.7K
R648-650,655-657	RES, 5.1K,5%, 125MW, METAL FILM (1206)	R-375-5.1K
R663,677,781-783	RES,4.7K,5%,125MW,METAL FILM(1206)	R-375-4.7K
R665	RES, 470,5%, 125MW, METAL FILM(1206)	R-375-470
R667,669	RES, 560, 5%, 250mW, METAL FILM (1210)	R-376-560
R668,717,720	RES, 10K, 5%, 250MW, METAL FILM(1210)	R-376-10K
R670,675	RES,100,5%,250MW,METAL FILM(1210)	R-376-100
R714	RES, 4.7K, 5%, 250MW, METAL FILM(1210)	R-376-4.7K
R716	RES, 1M, 5%, 250MW METAL FILM (1210)	R-376-1M
R718,719	RES,1K, 5% 250MW, METAL FILM (1210)	R-376-1K
R732,749,771	RES,10K,5%,125MW,METAL FILM(1206)	R-375-10K
R743-748,752-755,757, 769,774,	RES, 100, 5%, 125MW, METAL FILM (1206)	R-375-100
R758-763	RES, 39, 5%, 125MW, METAL FILM(1206)	R-375-39
R772	RES,47K,5%,125MW,METAL FILM(1206)	R-375-47K
R787	RES, 510, 5%, 125MW, METAL FILM(1206)	R-375-510
R788	RES, 33.2, 1%, 100MW, THICK FILM(0805)	R-418-33.2
R789,791	RES, 110K, 1%, 100MW, THICK FILM(0805)	R-418-110K
R792,790	RES, 576K, 1%, 100MW, THICK FILM(0805)	R-418-576K
R793	RES, 20, 1%, 100MW, THICK FILM(0805)	R-418-20
TP602-603	CONN,TEST POINT	CS-553

Table 4-4 (cont.)
Model 6517 digital board, parts list

Circuit designation	Description	Keithley part number
U612	IC,350MA SATURATED SINK DRIVER UDN-2596A	IC-578
U614	IC,OCT BFR/LINE DRIVE,74HCT244(SOLIC)	IC-651
U615,630	IC, QUAD 2 IN NOR, 74HCT02 (SOIC)	IC-809
U616	IC, QUAD 2 INPUT OR, 74HCT32 (SOIC)	IC-808
U621	IC,OCTAL INTERFACE BUS,75160(SOLIC)	IC-646
U622	IC, GPIB ADAPTER, 9914A (PLCC)	LSI-123
U623	IC,OCTAL INTER BUS TRANS,75161(SOLIC)	IC-647
U628	IC, VOLT COMPARATOR LM393D(SOIC)	IC-775
U629,642	IC,+5V VOLTAGE REGULATOR,LM2940CT	IC-576
U631	IC, 16-BIT MICRO, MC68302FC	LSI-144
U634	IC, SERIAL E EPROM, X24164(8-PIN DIP)	IC-885
U635,636	IC,125KX8 STAT CMOS RAM,HM628128LFP-10	LSI-133-100
U639	IC, MICROMANAGER, DS12365-10(SOLIC)	IC-884
U640	IC, 64X8 CMOS SRAM MK41756N00	IC-946
U641	IC +5V RS-232 TRANSCEIVER, MAX202(SOIC)	IC-952
U643	IC, VOLT CONVERT, LT 1026	IC-959
U652	IC, PROG, VOLT, REG, ICL7664	IC-883
U653	IC, PROG, VOLT, REG, ICL7663	IC-882
VR602	DIODE, ZENER 4.7V, IN4732A (DO-41)	DZ-67
W607-610	CONN,3 PIN	CS-339-3
W607-610	CONNECTOR, JUMPER	CS-476

Table 4-5
Model 6517 mechanical board, parts list

Circuit designation	Description	Keithley part number
	.020 VINYL STOCK	D-1
	BEZEL, REAR	428-303D
	CARD GUIDE, LONG	2001-315A
	CARD GUIDE, SHORT	2001-316A
	CHASSIS ASSEMBLY	6517-305B
	CLIP, REGULATOR	6517-324A
	COLLAR	6517-323A
	CONDUCTIVE RUBBER SWITCH	6517-310A
	CONNECTOR FOR SC-146, SC-147	CS-236
	CONNECTOR FOR SC-68-0,-2,SC-144-2,-3,-4,	CS-236
	CONNECTOR FOR SC-71-1, SC-71-6	CS-276
	CONNECTOR, HARDWARE KIT IEEE CS TO R. PANEL	CS-713
	COVER	6517-319B
	COVER PANEL, SCANNER	2001-372A
	CRIMP CONTACT ROUND FOR SC-147	CS-760
	DISPLAY LENS	6517-307B
	FOOT	428-319A
	FOOT, EXTRUDED	FE-22A
	FOOT, RUBBER	FE-6
	GASKET	GA-30A
	HANDLE	428-329F
	INSULATOR	27493-46V
	INSULATOR	27493-47V
	INSULATOR	27493-48V
	LENS, LED	6517-309A
	LUG FOR SC-73-5	LU-88
	MOUNTING EAR, LEFT	428-338B
	MOUNTING EAR, RIGHT	428-328E
	OVERLAY, FRONT PANEL	6517-312A
	PAD, THERMAL	HS-47A
	PC BOARD STOP	2001-371A
	PLASTIC PLUG COVER PLATE TO R. PANEL	FA-240
	POWER ROD	2001-320A
	PRINTED FRONT PANEL	6517-302B
	RFI CLIP, CHASSIS	2001-366-14A
	RFI CLIP, CHASSIS	2001-366-5A
	SCREWLOCK, FEMALE RT ANGLE CS TO R. PANEL	CS-725
	SHIELD, A/D BOTTOM	6517-316A
	SHIELD, A/D TOP	6517-317A
	SHIELD, ELECTROMETER BOTTOM	6517-315A
	SHIELD, ELECTROMETER TOP	6517-314A
	SHIELD, INPUT WIRE FOR CS-630	6517-320A
	SHORTING LINK	BP-6
	SPACER	6517-322A
	TRANSFORMER	TR-297A

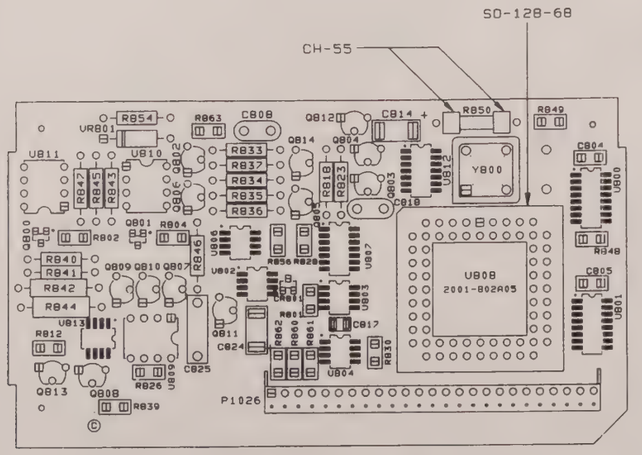
Table 4-5 (cont.)
Model 6517 mechanical board, parts list

Circuit designation	Description	Keithley part number
DS301	LED, HIGH POWER	PL-94
J1001	CONN, AC RECEPTACLE (LINE FILTER)	LF-6-1
J1003	CONNECTOR TRIAX	CS-630
J1004	BINDING POST, YELLOW	BP-11-7
J1005	BINDING POST, BLACK	BP-11-0
J1006	BINDING POST, BLUE	BP-11-6
J1007	BINDING POST, GREEN	BP-11-5
J1008	BANANA JACK, PUSH-IN, RED	BJ-13-2
J1009	BANANA JACK, PUSH-IN, BLACK	BJ-13-0
J1017	CONNECTOR, 4-PIN MALE	CS-458
P1002	CONN, MOLEX HEADER	CS-716-3
P1019,P1020	CONNECTOR	CS-627
P1021-1023	CONNECTOR, HOUSING	CS-638-3
P1030	CONN, BERG HOUSING	CS-638-4

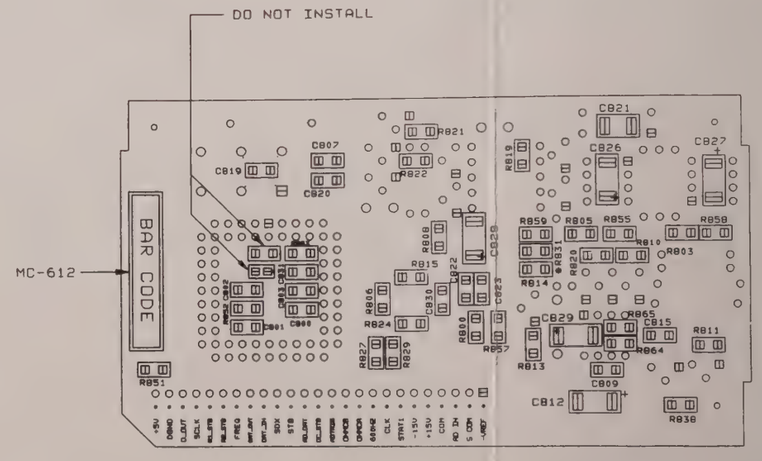
Table 4-6
Model 6517 miscellaneous parts list

Description	Keithley part number
LINE CORD	CO-7
CAP, PROTECTIVE	CAP-31
SOFTWARE DISK	6517-DSK-81

LTR	ECO NO.	REVISION	ENG.	DATE
E	911015	RELEASED	MS	10/15/91
E1	14971	REVISED	SZ	12/17/91
F	15061	ARTWORK REV WAS E. ADDED C831.	SZ	1/17/92
G	15224	[illegible]	AS	5/4/92
G1	15473	ADDED 2001-802905 UNDER U808.	SZ	10/2/92
G2	15656	P1026 WAS P1036A.	AS	2/20/93
H	16152	[illegible]		2/11/94
J	16466	CHG'D ARTWORK FROM REV H TO J.		



COMPONENT SIDE (SIDE -04)



• DO NOT INSTALL R831

SOLDER SIDE (SIDE -01)

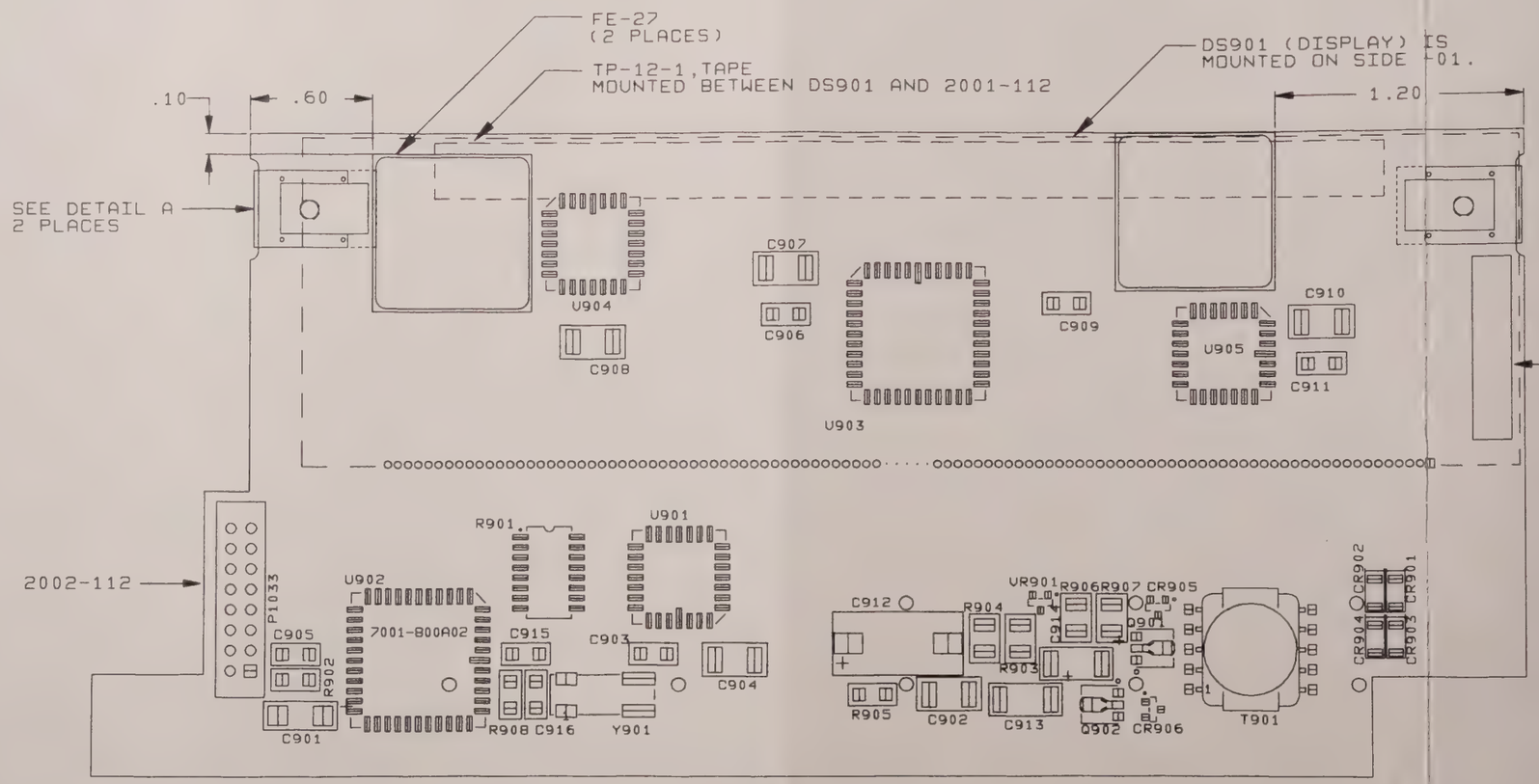
NOTES:
1. FOR COMPONENT INFORMATION, REFER TO MODEL 2001 PRODUCT STRUCTURE.
2. COMPONENT SIDE SOLDER PASTE STENCIL: 2001-168-04 REV J
3. SOLDER SIDE GLUE STENCIL: 2001-168.2-01 REV J

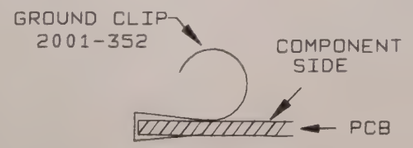
MODEL	NEXT ASSEMBLY	QTY.
USED ON		

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 10-12-91	SCALE 2:1	TITLE COMPONENT LAYOUT, A/D CONVERTER
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.01 ANG.=±1°	DRN. CB	ENG. APPR.	
	XXX=±.005 FRAC.=±1/64	MATERIAL		D NO. 2001-160
	SURFACE MAX. 63	FINISH		

2002-110 ON

LTR.	ECO NO.	REVISION	ENG.	DATE
A	16343	RELEASED	SZ	2-2-94
A1	16802	ADDED 7001-800A02.	SZ	11-1-94
A2	16924	ADDED (2) FE-27'S		3-2-95





DETAIL A

NOTES: 1. FOR MORE COMPONENT INFORMATION REFER TO 2002 PRODUCT STRUCTURE.
2. REQUIRES NO BOTTOM SIDE GLUE STENCIL.
3. REQUIRES TOP SIDE SOLDER PASTE STENCIL #2002-118-02A.

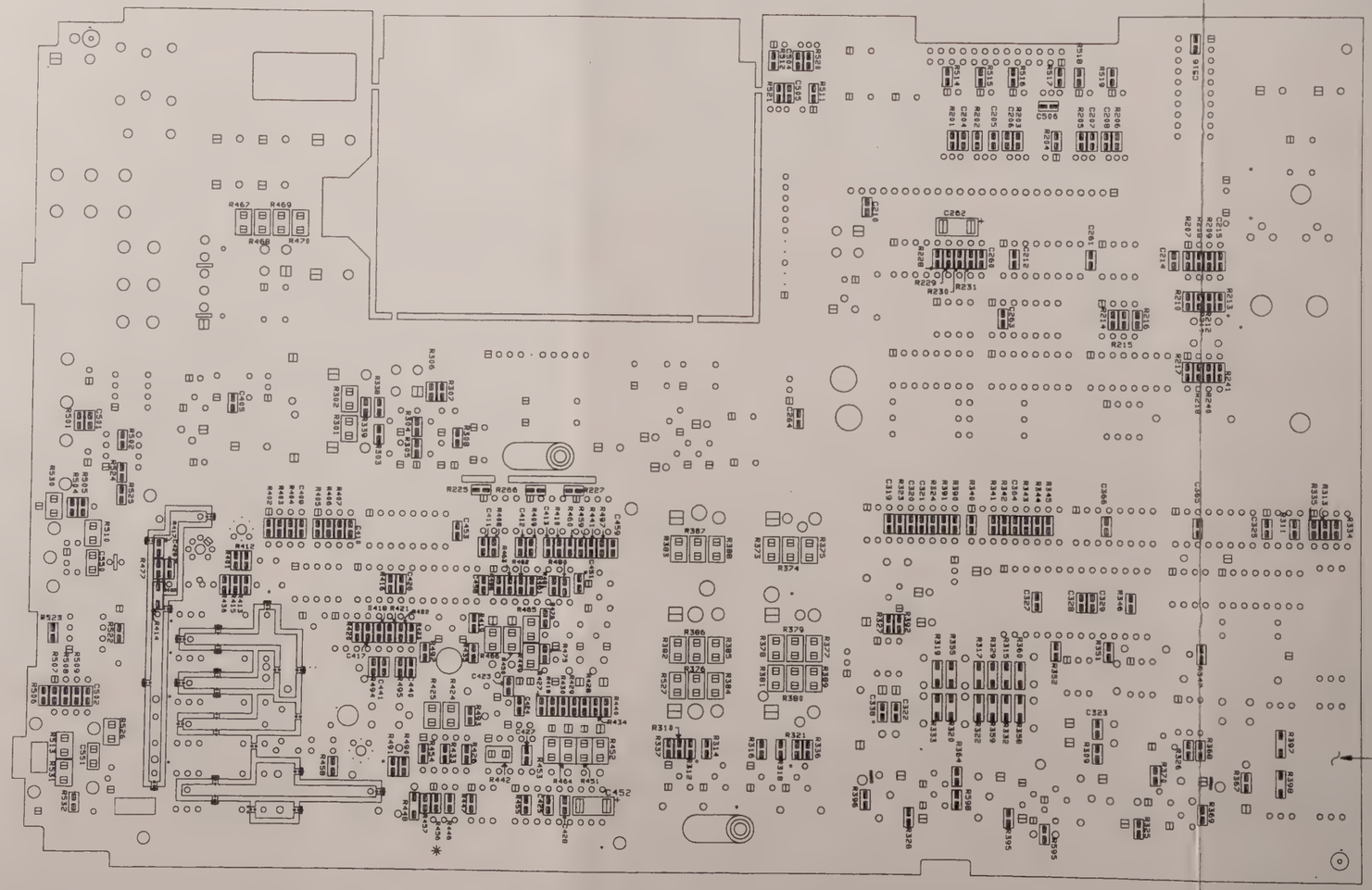
2002		1
MODEL	NEXT ASSEMBLY	QTY.
USED ON		

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 1/24/94	SCALE	TITLE COMPONENT LAYOUT, DISPLAY BOARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.010 ANG.=±1°	DRN. MAH	ENG. APPR. PS/CM	
	XXX=±.005 FRAC.=±1/64	MATERIAL		B NO. 2002-110
	SURFACE MAX. 63	FINISH		

NO. 6517-100

LTR.	ECO NO.	REVISION	ENG.	DATE
A		PRELIMINARY		10/6/93
B		PRELIMINARY		2/28/94
C	940520	RELEASED		5/20/94
D	16744	REVISED, ADDED R494-497, R532, C263-264, C458-459. DELETED C552.		10/11/94

SOLDER SIDE VIEW



* NOTE:
DO NOT INSTALL
R456

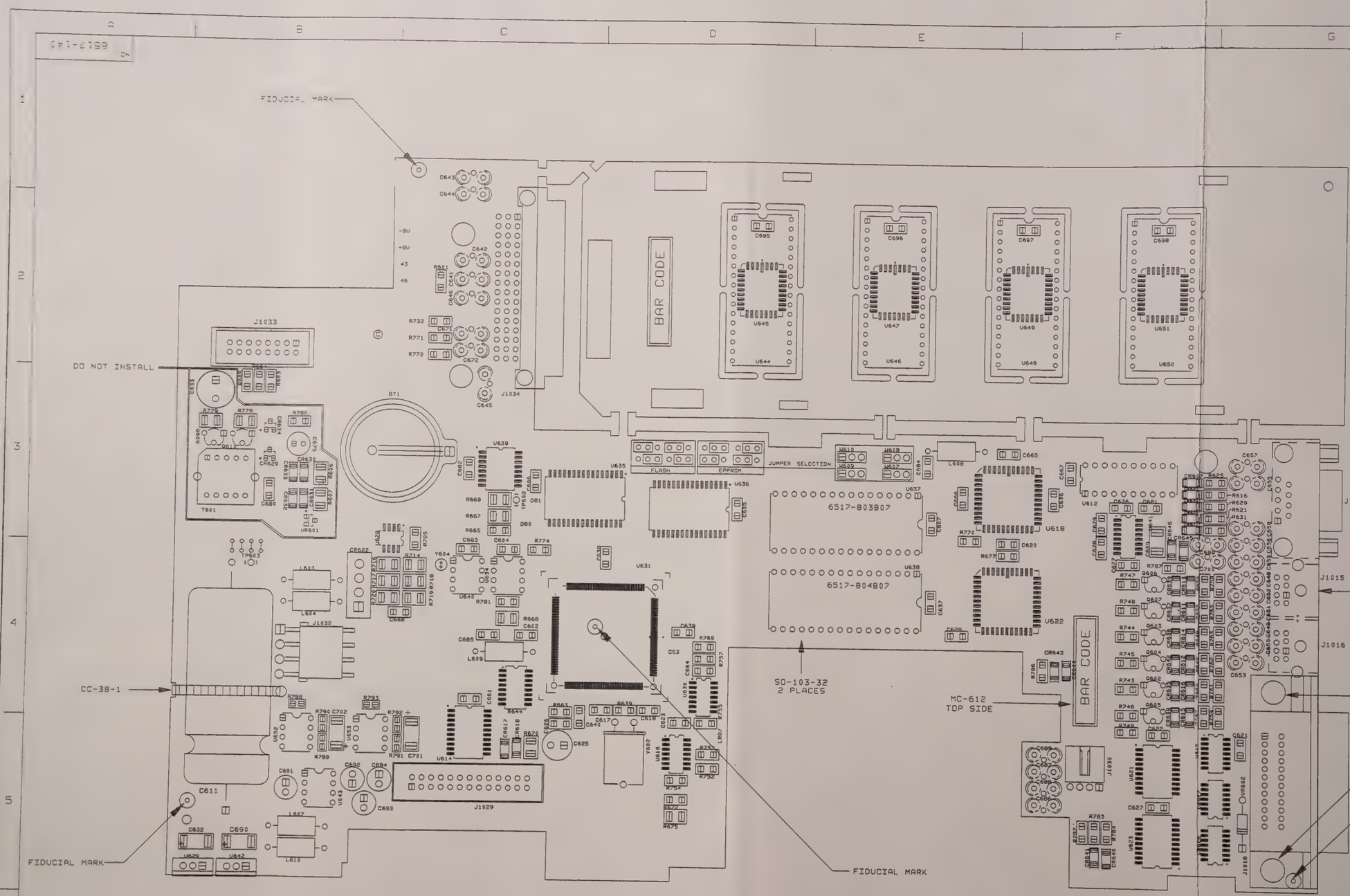
NOTE: FOR COMPONENT INFORMATION, REFER TO MODEL 6517 PRODUCT STRUCTURE.
USE GLUE STENCIL 6517-108-01D SOLDER SIDE GLUE STENCIL.

MODEL	NEXT ASSEMBLY	QTY.
6517		
USED ON		

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 10/5/94	SCALE 5:4	TITLE COMPONENT LAYOUT ANALOG BOARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.015 ANG.=±1°	DRN. KEK	ENG. APPR. JM	
	XXX=±.005 FRAC.=±1/64	MATERIAL		C NO. 6517-100
	SURFACE MAX. 63	FINISH		

PC 2 OF 2

6517-140 (DIGITAL BOARD) REVISION CONTROL				
LTR.	ECO NO.	REVISION	ENG.	DATE
B		PRELIMINARY	SZ	5-18-94
C	940518	RELEASED	SZ	5-18-94
C1	16891	ADDED 6517-803B04 & 6517-804B04.	AS	11-22-94
C2	16955	6517-803B03 WAS 6517-803B04 AND 6517-804B03 WAS 6517-804B04	SZ	1-5-95
C3	17062	6517-803B06 WAS 6517-803B05 AND 6517-804B06 WAS 6517-804B05	SZ	3-17-95
C4	17127	6517-803B07 WAS 6517-803B06 AND 6517-804B07 WAS 6517-804B06	SZ	3-17-95



NOTE: FOR MORE COMPONENT INFORMATION REFER TO 6517 PRODUCT STRUCTURE.

USE ARTWORK NUMBER 6517-148-04C FOR SOLDER PASTE STENCIL.

MODEL	NEXT ASSEMBLY	QTY. USED ON
6517		

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 9/9/93	SCALE 2:1	TITLE COMPONENT LAYOUT, DIGITAL BOARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.015 ANG.=±1°	DRN. MAW	ENG. R.KROPP APPD.	
	XXX=±.005 FRAC.=±1/64	MATERIAL		D NO. 6517-140
	SURFACE MAX. 63	FINISH		

6517-140 (DIGITAL BOARD) REVISION CONTROL

LTR.	ECO NO.	REVISION	ENG.	DATE
B		PRELIMINARY	SZ	5-18-94
C	940518	RELEASED	SZ	5-18-94
C1	16891	ADDED 6517-803804 & 6517-804804.	AS	11-22-94
C2	16950	6517-803803 WAS 6517-803804 AND 6517-804803 WAS 6517-804804.	SZ	1-5-95
C3	17062	6517-803806 WAS 6517-803803 AND 6517-804806 WAS 6517-804803.	SZ	3-17-95
C4	17127	6517-803807 WAS 6517-803806 AND 6517-804807 WAS 6517-804806.		

FIDUCIAL MARK

DO NOT INSTALL

CC-38-1

FIDUCIAL MARK

SD-103-32
2 PLACES

MC-612
TOP SIDE

FIDUCIAL MARK

6517-140
(DIGITAL BOARD)

4-40X5/16 PPH
2 REQ'D

FIDUCIAL MARK

BAR CODE

BAR CODE

FLASH

EPROM

JUMPER SELECTION

6517-803807

6517-804807

NOTE: FOR MORE COMPONENT INFORMATION REFER TO 6517 PRODUCT STRUCTURE.

USE ARTWORK NUMBER 6517-148-04C FOR SOLDER PASTE STENCIL.

6517		
MODEL	NEXT ASSEMBLY USED ON	QTY.

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 9/9/93	SCALE 2:1	TITLE COMPONENT LAYOUT, DIGITAL BOARD
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44130	XX=±.015 ANG.=±1°	DRN. MAH	ENG. R.KROPP APPR.	
	XXX=±.005 FRAC.=±1/64	MATERIAL		D NO. 6517-140
	SURFACE MAX. 63	FINISH		

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Service Form

Model No. _____ **Serial No.** _____ **Date** _____

Name and Telephone No. _____

Company _____

List all control settings, describe problem and check boxes that apply to problem. _____

_____

_____

- ❑ Intermittent
- ❑ IEEE failure
- ❑ Front panel operational
- ❑ Analog output follows display
- ❑ Obvious problem on power-up
- ❑ All ranges or functions are bad
- ❑ Particular range or function bad; specify _____
- ❑ Batteries and fuses are OK
- ❑ Checked all cables

Display or output (check one)

- ❑ Drifts
- ❑ Unstable
- ❑ Overload
- ❑ Unable to zero
- ❑ Will not read applied input

- ❑ Calibration only
- ❑ Data required
- ❑ Certificate of calibration required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

_____

_____

What power line voltage is used? _____ Ambient temperature? _____ °F

Relative humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe.)

_____

_____

Be sure to include your name and phone number on this service form.

KEITHLEY

Test Instrumentation Group
Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139

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Model 6517 Repair Manual Addendum

INTRODUCTION

This manual addendum is being provided in order to quickly supply you with the latest information available. Please review these changes and incorporate them into the manual before operating or servicing the unit.

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